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# Prevalence of Lateral Violence in Nurse Workplace

A systematic review and meta-analysis

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Prevalence of Lateral Violence in Nurse Workplace: A systematic review and meta-analysis

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Abstract

Objective: The prevalence of inter-nurse lateral violence (LV) reported in current studies is inconsistent, ranging from 7% to 83%. The purpose of this systematic review and meta-analysis is to quantify the prevalence of LV in nurses’ workplaces.

Methods: Cochrane, PubMed, Embase, CINAHL, CNKI and Wanfang databases were systematically searched for relevant studies (up to January 27, 2021). Stata 16.0 was used for statistical analysis. Fixed-effect or random-effect model was adopted
according to heterogeneity which was evaluated by Cochran’s $Q$ and $I^2$ values. Sensitivity analysis, subgroup analysis and meta-regression were performed to investigate the sources of heterogeneity.

**Results:** A total of 14 studies with 6,124 nurses were included in the systematic review. Further, thirteen articles with 5,745 nurses were included in the meta-analysis, and the pooled prevalence of LV among nurses was 33.08% (95% CI: 23.41%-42.75%, $P<0.05$; $I^2=99.0\%$). The remaining one study containing 370 samples reported that the prevalence of inter-nurse LV was 7.92%. Subgroup analysis showed region, sample size, sampling, study’s quality, response rate and publication time might not be the sources of heterogeneity. Meta-regression indicated that sample size had the main influence on model heterogeneity. Egger’s test showed the existence of publication bias ($P=0.03$).

**Conclusion:** The prevalence of inter-nurse LV is high in nurse workplace. It is suggested that scholars pay more attention to the cultural differences of inter-nurse LV between regions in the future.

**Keywords:** prevalence; lateral violence; nurse workplace; meta-analysis

**Strengths and limitations of this study**

- The present systematic review will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.
- The present study has an established aim, stringent inclusion and exclusion criteria, and a precise quality evaluation and quantitative synthesis.
- It discusses the impact by subgroup analysis of the possible causes lateral violence prevalence
• Two reviewers will independently screen for eligibility and data extraction, with a third reviewer mediating when a disagreement arises, thus ensuring that reviewer bias is minimised.

• Many countries lack studies on the prevalence of lateral violence, which may affect the representativeness of the results

1. Introduction

Lateral violence (LV), which belongs to internal workplace violence, refers to inter-group conflict, manifested by sabotage, infighting, scapegoating, criticism and other explicit and implicit non-physical hostilities (1). It focuses on the negative behavior between peers with the same social status in the work environment, that is, the intimidation behavior between peers (2). Previous studies, which focused LV abusers on colleagues, nurses outside the department, and nursing managers, reported that LV is more common in nursing profession. It has been indicated that inter-nurse LV may have a negative impact on individual physical and mental health, such as causing nurses’ job burnout, post-traumatic stress disorder and other adverse consequences. In addition, LV among nurses may have a serious negative influence on the whole nursing team, increased turnover tendency of nurses and work burden of clinical nurses as examples (2-5). Therefore, LV in the workplace of nurses must be given sufficient attention.

Importantly, we need first understand the specific prevalence of inter-nurse LV in nurse workplace before developing and implementing interventions to improve this situation. However, the results of the current studies reporting on the prevalence of LV in nurse workplace are inconsistent. One study from US reported that 85% nurses suffered from LV (6), while another study in the US indicated that about 22% of nurses reported been subjected to violence from their colleagues (7). Studies
occurred in Korea showed that LV prevalence among nurses ranged from 11.5% to 40% (8, 9). Another study from China reported that about 83% of neurologic nurses had suffered from inter-nurse LV (10). To date, no systematic review and meta-analysis has been published on synthesis of LV prevalence in nurse workplace. Therefore, the purpose of this review is to quantify the prevalence of LV prevalence among nurses in nurse workplace.

2. Methods

This systematic review and meta-analysis was conducted on the basis of the preferred report items in the Preferred Reporting Items for Systemic Reviews and Meta-Analyses (PRISMA) guidelines.

2.1. Search strategy

Articles related to the prevalence of LV in nurse workplace were retrieved from four English databases of Cochrane, PubMed, Embase and CINAHL and two Chinese databases of CNKI, Wanfang (from inception to January 27, 2021). Keywords used for searching were “lateral violence” (including “horizontal violence”, “horizontal hostility”, “bullying place”, “incivility”) and nurse, with the retrieval adjusted according to the database. We also reviewed the list of references in the included studies to obtain additional studies.

2.2. Inclusion/Exclusion criteria

Inclusion criteria were that: (1) both abuser and victim were nurses; (2) articles reported the data of LV prevalence in nurse workplace; (3) LV was measured by self-report; (4) research design was cross-sectional, or case control, or cohort (using baseline data).

Exclusion criteria were: (1) meeting abstract, case reports, review, meta-analysis, letter, pilot study, qualitative study; (2) the abuser is not identified or the
specific data of the abuser is not provided; (3) duplicate articles and/or data (When there are different articles in the same unit and the same sample, selected the most recent article.); (4) studies with unclear descriptions of nurse populations and events.

Two reviewers screened the literature independently according to the inclusion and exclusion criteria, and a third reviewer made judgment if there were conflicts.

2.3. Data extraction and quality assessment

Data was extracted independently by two investigators from eligible studies, and a third investigator cross-checked for accuracy. Data extracted included the first author, publication time, country, sample size, event (number of nurses subjected to LV), gender, age, measurement of LV, sampling, response rate, and prevalence of LV among nurses.

Quality of the included studies was evaluated using the modified Newcastle-Ottawa Scale (M-NOS)\(^\text{[11]}\). There are 5 items, with 1 point for each "Yes" answer and 0 point for each "No" answer. The total score ranges from 0 to 5, with higher scores indicating better quality. In this study, ≥3 was defined as low-risk bias and <3 as high-risk bias.

2.4. Data analysis

Stata 16.0 was used for statistical analysis. Cochran's chi-square test (Cochran's Q value) and \(I^2\) value were adopted to assess heterogeneity, with \(P<0.05\) or \(I^2>50\%\) indicating significant heterogeneity between studies. Fixed-effect model was performed to calculate the pooled prevalence of LV in nurse workplace when there was no significant heterogeneity, and random-effect model was used otherwise. Subgroup analysis, sensitivity analysis and meta-regression analysis were conducted to explore the sources of heterogeneity. Funnel plots and egger test were conducted to evaluate publication bias.
3. Result

3.1. Study selection

A total of 14 articles were included in this systematic review, involving 6,124 nurses. Sample size of the included studies ranged from 118 to 1,690. Among those studies, 13 were included in the meta-analysis, with the detailed showed in Figure 1.

3.2. Basic information of the included studies

In this systematic review, 3 researches occurred in the Americas (7, 12, 13), 10 in Asia (3-5, 8, 9, 14-17) and 1 in Europe (18). The prevalence of LV among nurses ranged from 6.83% to 82.68%. The lowest prevalence of LV was found in an American study and the highest in a study from China. With regard to the quality measured by M-NOS, 5 studies got <3 points and 9 researches got ≥3 points. Details are shown in Table 1(Table 1A and Table 1B).
Table 1A Characteristics of the included 14 studies

| Study                  | Country  | Participants          | Sampling     | Response Rate | Sample Size | Gender (W:M) | Age (mean) | Quality Score |
|-----------------------|----------|-----------------------|--------------|---------------|-------------|--------------|------------|---------------|
| Vessey et al (2009)   | US       | Registered nurses     | Random       | 100%          | 303         | 289:14      | 49         | 4             |
| Hampton et al (2019)  | US       | Nursing Leaders       | Convenience  | 1.8%          | 175         | 166:9       | 54         | 2             |
| Pien et al (2019)     | China    | Nurses                | Convenience  | 94.7%         | 1690        | 1690:0      | 33.4       | 3             |
| Park et al (2015)     | South Korea | Registered nurses   | Convenience  | 94.4%         | 970         | 970:0       | 28.6       | 3             |
| Al-Surimi et al (2020)| Saudi Arabia | Nurses             | Convenience  | 48.3%         | 519         | 922:152     | 38.77      | 2             |
| Pai et al (2011)      | China    | Registered nurses     | Random       | 77.9%         | 521         | 498:23      | 36.2       | 4             |
| Rayan et al (2019)    | Saudi Arabia | Nurses             | Random       | 98%           | 118         | 77:41       | 29.14      | 2             |
| Difazio et al (2019)  | Russia   | Registered nurses     | Random       | 0.32%         | 438         | 392:10      | 20.56      | 4             |
| Johnson et al (2009)  | US       | Registered nurses     | Random       | 32.5%         | 249         | 204:45      | 48.81      | 4             |
| Chang et al (2016)    | Korea    | Registered nurses     | Convenience  | 44.01%        | 312         | 294:18      | 23.7       | 3             |
| Li et al (2017)       | China    | Nurses                | Convenience  | 95.77%        | 136         | 120:16      | —          | 1             |
| Wang et al (2018)     | China    | Nurses                | Convenience  | 94.4%         | 187         | 187:0       | 35.42      | 3             |
| Wu et al (2017)       | China    | Neurosurgery Nurses   | Convenience  | 100%          | 127         | 122:5       | 26.47      | 2             |
| Cheung et al (2017)   | China    | Nurses                | Random       | 5.3%          | 379         | 303:76      | 34:44      | 4             |

W: woman; M: man
Table 1B LV-related characteristics of the 14 included studies

| Study             | Measurement                                                                 | Event | Prevalence |
|-------------------|-----------------------------------------------------------------------------|-------|------------|
| Vessey et al (2009) | A 30-item anonymous electronic survey was created in SurveyMonkey         | 31    | 0.10       |
| Hampton et al (2019) | NAQ-R                                                                      | 38    | 0.22       |
| Pien et al (2019)   | A self-administered questionnaire was used to record the nurses’ experiences of workplace violence, including types (physical, psychological, verbal and sexual) and sources (internal and external) of violence | 228   | 0.13       |
| Park et al (2015)   | COPSOQ II                                                                  | 112   | 0.12       |
| Al-Surimi et al (2020) | It was sourced from an integrative literature review by Houck and Colbert. Responses to 15 themes were rated on a 5-point Likert scale | 186   | 0.36       |
| Pai et al (2011)    | WVQ                                                                         | 169   | 0.32       |
| Rayan et al (2019)  | The modified version of the Joint Programme on Workplace Violence in the Health Sector published by the International Labour Office | 21    | 0.18       |
| Difazio et al (2019) | The Bullying in the Workplace 26-itemsurvey                               | 79    | 0.18       |
| Johnson et al (2009) | NAQ-R                                                                      | 17    | 0.07       |
| Chang et al (2016)  | COPSOQ II                                                                  | 125   | 0.40       |
| Li et al (2017)     | Lateral violence questionnaire compiled by Gao Yingying                     | 96    | 0.71       |
| Wang et al (2018)   | Lateral violence questionnaire compiled by Li XY                            | 135   | 0.72       |
| Wu et al (2017)     | SS                                                                          | 105   | 0.83       |
| Cheung et al (2017) | Workplace violence in the health sector country case studies research instruments survey questionnaires”(English version) | 30    | 0.08       |

LV: lateral violence; NAQ-R: Revised Negative Acts Questionnaire; COPSOQ II: the second version of the medium-sized Copenhagen Psychosocial Questionnaire; WVQ: a Chinese-language version of the Workplace Violence Questionnaire; SS: sabotage savvy
3.3. Pooled prevalence of LV in nurse workplace

As sensitivity analysis showed that among the 14 eligible studies, one study (17) had a great influence on the overall result, affected the stability, we eliminated this paper in the quantitative synthesis. Moreover, we qualitatively described this paper, that: This research published in 2017, was conducted by Cheung and Yip in Hong Kong, China, with a random sample of 370 nurses and response rate of 5.3% (Data was collected through the network). LV is measured by self-rating scale, and thirty of 370 had experienced inter-nurse LV, with the prevalence of 7.92%. The scale quality evaluation score was 4 points (Table 1A and Table 1B).

Finally, a total of 13 studies were included in the meta-analysis. The pooled prevalence of LV among nurses was 33.08% (95% CI: 23.41%-42.75%; I²=99.0%, P<0.001) (Figure 2).

3.4. Subgroup analysis

Subgroup analysis showed that the pooled LV prevalence in Asian and non-Asian regions was 41.6% (95%CI: 27.9-55.4%) and 13.9% (95%CI: 7.6-20.1%), respectively (Q=13.01, P<0.001). When the sample size was greater than 200, it was considered as large sample size, and the LV prevalence was 20.8% (95%CI: 14.0-27.7%), while in small sample size studies, it was 53.0% (95%CI: 25.7-80.3%) (Q=5.00, P=0.025). Rate of LV prevalence in studies with random sampling was 17.0% (95% CI: 7.9-26.1%), significantly lower than that of convenience sampling of 43.3% (95% CI: 28.1-58.5%) (Q=8.46, P= 0.004). 2016 previously published research and published in 2016-2020 study rate of 15.2% (95% CI: 6.1-24.3%), 41.3% (95% CI: 25.8-56.7) (Q=8.13, P=0.004). Additionally, researches with low quality reported higher LV prevalence than that of high quality (51.7% vs 24.9%). The LV prevalence in studies with response rate <50% was 24.4%, while in ≥50%, it was 38.6%
(P=0.143). However, none of the factors above might be a source of heterogeneity (Table 2).

| Subgroup         | Studies | Pooled Prevalence (95%CI) | I²  | Test of Difference within Each Subgroup |
|------------------|---------|---------------------------|-----|----------------------------------------|
| Region           |         |                           |     |                                        |
| Asia             | 9       | 0.42(0.28,0.55)           | 99.2%|                                        |
| Non-Asia         | 4       | 0.14(0.08,0.20)           | 90.6%|                                        |
| Sample Size      |         |                           |     |                                        |
| ≥200             | 8       | 0.21(0.14,0.28)           | 97.7%|                                        |
| <200             | 5       | 0.53(0.26,0.80)           | 98.8%|                                        |
| Sampling         |         |                           |     |                                        |
| Random           | 5       | 0.17(0.08,0.26)           | 96.3%|                                        |
| Convenience      | 8       | 0.43(0.28,0.59)           | 99.3%|                                        |
| Quality Score    |         |                           |     |                                        |
| High Risk        | 4       | 0.52(0.24,0.79)           | 98.8%|                                        |
| Low Risk         | 9       | 0.25(0.16,0.33)           | 98.4%|                                        |
| Response Rate    |         |                           |     |                                        |
| <50%             | 5       | 0.24(0.12,0.37)           | 97.8%|                                        |
| ≥50%             | 8       | 0.39(0.24,0.53)           | 99.3%|                                        |
| Publication Time |         |                           |     |                                        |
| <2016            | 4       | 0.15(0.06,0.24)           | 97.3%|                                        |
| 2016-2020        | 9       | 0.41(0.26,0.57)           | 99.1%|                                        |

P<0.05*, P<0.01**, P<0.001***

3.5. Meta-regression analysis

Meta-regression was performed on region, sample size, sampling, quality score, response rate and publication time in the subgroup. The results showed that the prevalence of LV among nurses was higher in small sample studies (β=0.1176, P=0.016). In the result, sample size accounted for 80.48% of the overall heterogeneity. (Table 3)

| Variables, Asia | B     | 95% CI Lower | 95% CI Upper | R²   | P value |
|-----------------|-------|--------------|--------------|------|---------|
| Region          | 0.1345| -0.0544      | 0.5376       | 19.31%| 0.100   |
3.6. Sensitivity analysis and publication bias

Sensitivity analysis was conducted on the included 14 studies, and it was found that one article had a significant impact on the results (Figure 3). Therefore, this article was described separately. The left 13 studies were finally included in meta-analysis, and the result was unchanged by serially excluding each study (Figure 4). Funnel plots and egger's test indicated the existence of publication bias in the 13 studies ($P=0.003$) (Figure 5 & Figure 6).

4. Discussion

This systematic review included 14 studies with a total sample size of 6,124 nurses. The meta-analysis showed that the pooled prevalence of LV among nurses was 33.08% (95% CI: 23.41%-42.75%). According to existing research, this systematic review and meta-analysis is the first to synthesis the prevalence of LV in nurse workplace worldwide.

Subgroup analysis revealed that there were significant differences in the overall prevalence of LV in Asia and non-Asian regions. The prevalence of LV in Asia (41.6%) is higher than that of non-Asian LV (13.9%). The possible reason may be that Asian and non-Asian cultural backgrounds are different, leading to differences in their understanding and handling of LV. In the context of collectivism in Japan, South Korea, and other Asian countries, harmony and group norms are more valuable,
which may lead to differences in the definition of LV between the collectivist cultural background and the Western cultural background (19). As fewer countries are involved in this meta-analysis, it is recommended to carry out studies on LV prevalence among nurses in more regions in the future.

The result showed significant differences in LV prevalence between different sampling methods and sample sizes. In order to facilitate sampling, participants from one or several departments are usually selected for research, but there are differences in LV prevalence between departments and different working environments (8, 13, 16, 20, 21). The working environment and atmosphere of the selected personnel lack universality, resulting in differences between different sampling methods. With regard to sample size, it has been shown that in studies with smaller participants, due to selection bias and publication bias, more extreme prevalence estimates tend to be obtained (22). Therefore, researchers should be more cautious when analyzing the impact of sample size and sampling method on prevalence.

Chen et al (1) summarized and analyzed the research published by LV and found that the number of articles published before 2014 was less than 10, but it started to increase after 2015. Compared with other research fields, this may be related to the fact that this field is a new field. The development time of this field is not very long, the early stage is still in the exploratory stage, the research is not deep enough, and a large number of theoretical and practical explorations have begun in the later stage. Therefore, this study uses 2015 as the time point for observing the difference in prevalence. Subgroup analysis shows that the prevalence of LV varies at different publication times. The higher prevalence of LV reported after 2016 may be related to the fact that society has begun to attach importance to the concept of LV and has increased people's self-protection awareness after 2016. For the studies included in the
meta-analysis, the prevalence of the three studies all exceeded 70%, all of which were from China and were published after 2016. The second study is from South Korea, both of which are developing countries in Asia. It is estimated that in developed countries in Europe and America, the total prevalence of LV is about 14%, which is very different. It is recommended that future studies consider comparing the LV prevalence between developing and developed countries.

Among all the included Chinese studies, this single analysis had the lowest LV prevalence. Their analysis of the results believes that it has something to do with the nurse's attitude. They thought report violent behavior will not change anything. It is similar to the attitude of subjects in an empirical analysis study on how to deal with workplace bullying (7). This attitude may make nurses choose to endure silently, leading to insufficient reporting, resulting in measured values lower than true values, which can explain the low response rate. The results also show that unhappiness among colleagues is an important factor in workplace LV. It is suggested that the occurrence of LV may be related to a stressful environment, such as the zero tolerance attitude of the Hong Kong health department towards nursing negligence and media public opinion. Nurses are afraid of being blamed for jeopardizing their careers, are unwilling to help colleagues, and lack team cohesion. The formal nurses or old nurses are easy to despise or attack other nurses. The tedious and high-pressure work will make nurses prone to physical and mental exhaustion. If they are subjected to LV again, their physical and mental health and work (Efficiency and performance) will be affected (15, 16, 23, 24). And further affect the nursing team atmosphere and quality have a negative impact, so nurses under this pressure may cause the occurrence of LV.

When looking for sources of heterogeneity, subgroup analysis suggested that each subgroup variable we set was not a source of heterogeneity; and meta-regression
showed that sample size might be a source of heterogeneity. Sensitivity analysis of 14 articles showed that one study would affect the overall research results. Sensitivity analysis was conducted again after removing this paper, and the results showed the stability. There was publication bias in this meta-analysis, which may exaggerate the results of this study. Therefore, it is necessary to be more rigorous in the generalization of the conclusion.

This study has the following limitations. Firstly, more than half of the studies included were in countries in the Asian region, and many countries lacked studies on prevalence of LV, so this result may not be completely representative of the global level. Taking into account the inconsistent cultural background due to the medical environment in different regions, we recommended that more studies about LV in nurse workplace be carried out in different regions to understand the overall situation. Secondly, while we have excluded studies that did not define and measure descriptions, and where the description of the perpetrator was unclear, inconsistencies are still inevitable. That is, the measurement of LV in this systematic review and meta-analysis were all self-report, self-designed and self-administered questionnaires, which may lead to subjective and inconsistent data reports, as no standard assessment tool existed. Therefore, it is suggested that a standard, comprehensive and objective evaluation tool should be developed to measure LV in the future.

**Patient and public involvement**

No patient involved.

**Ethics and dissemination**

Ethical approval is not required for this study, as it is a systematic review. The results will be disseminated by the publication of the manuscript in a peer-reviewed journal, and national and international presentations.
5. Conclusion

The prevalence of LV in nurse workplace is high, with the rate of 33.08%, that nearly one third of nurses experienced violence from colleagues at work. As the LV among nurses may cause physical and mental damage, affect the health of nurses who are victims of violence, and even lead to a high turnover rate, researchers and administrators need to pay more attention.

Contributorship statement: YZ and JC searched and checked the databases according to the inclusion and exclusion criteria, extracted the data and assessed their quality. YZ analyzed the data and wrote the draft of the paper. SQ, RY, JC, HW and XS gave advice on meta-analysis methodology and revised the paper. All authors contributed to reviewing or revising the paper. LM is the guarantors of this work and had full access to all the data in the study and take responsibility for its integrity and the accuracy of the data analysis. All authors read and approved the final manuscript.

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Figure 1 Screening flow chart

Records identified through database searching (n=837) and additional records identified through other sources (n=0) after duplicates removed (n=510) are screened (n=114). Full-text articles assessed for eligibility (n=14) are included in qualitative synthesis (n=14). Studies included in quantitative synthesis (meta-analysis) (n=13).

132x125mm (300 x 300 DPI)
| Study ID       | n  | event | Effect (95% CI) | Weight |
|---------------|----|-------|----------------|--------|
| Vessey et al (2009) | 303 | 31    | 0.10 (0.07, 0.14) | 7.78   |
| Hampton et al (2019) | 175 | 39    | 0.22 (0.16, 0.29) | 7.62   |
| Pien et al (2010)     | 1690| 228   | 0.13 (0.12, 0.15) | 7.84   |
| Park et al (2015)     | 970 | 112   | 0.12 (0.10, 0.14) | 7.83   |
| Al-Surimi et al (2020) | 519 | 186   | 0.36 (0.32, 0.40) | 7.74   |
| Pai et al (2011)      | 521 | 169   | 0.32 (0.28, 0.36) | 7.75   |
| Rayan et al (2019)    | 116 | 21    | 0.18 (0.14, 0.22) | 7.77   |
| Difazio et al (2019)  | 438 | 79    | 0.18 (0.14, 0.22) | 7.76   |
| Johnson et al (2009)  | 249 | 17    | 0.07 (0.04, 0.10) | 7.79   |
| Chang et al (2016)    | 312 | 125   | 0.40 (0.35, 0.45) | 7.67   |
| Li et al (2017)       | 136 | 96    | 0.71 (0.63, 0.78) | 7.49   |
| Wang et al (2018)     | 187 | 138   | 0.72 (0.66, 0.79) | 7.59   |
| Wu et al (2017)       | 127 | 106   | 0.83 (0.76, 0.89) | 7.58   |
| Overall (I² = 99.0%, p = 0.000) | | | 0.33 (0.23, 0.43) | 100.00 |

NOTE: Weights are from random-effects model

Figure 2 Forest plot of eligible studies

273x199mm (300 x 300 DPI)
Figure 3 Sensitivity analysis estimating heterogeneity

301x201mm (300 x 300 DPI)
Figure 4 Sensitivity analysis estimating heterogeneity

301x201mm (300 x 300 DPI)
Figure 5 Funnel plots estimating small sample bias

209x152mm (300 x 300 DPI)
Figure 6 Egger's test estimating publication bias

209x152mm (300 x 300 DPI)
supplemental materials

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Legends:

Figure 1 Screening flow chart
Figure 2 Forest plot of eligible studies
Figure 3 Sensitivity analysis estimating heterogeneity
Figure 4 Sensitivity analysis estimating heterogeneity
Figure 5 Funnel plots estimating small sample bias
Figure 6 Egger’s test estimating publication bias
Prevalence of Lateral Violence in Nurse Workplace: A Systematic Review and Meta-analysis

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Prevalence of Lateral Violence in Nurse Workplace: A Systematic Review and Meta-analysis

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Abstract

Objective The prevalence of inter-nurse lateral violence (LV) reported in current studies is inconsistent, ranging from 7% to 83%. The purpose of this systematic review and meta-analysis is to quantify the prevalence of LV in nurses’ workplaces.

Design/setting Systematic review and meta-analysis. Cochrane, PubMed, Embase, CINAHL, CNKI and Wanfang databases were systematically searched for relevant studies (up to January 27, 2021). Stata 16.0 was used for statistical analysis. Fixed-effect or random-effect model was adopted
according to heterogeneity which was evaluated by Cochran’s $Q$ and $I^2$ values. Sensitivity analysis, subgroup analysis and meta-regression were performed to investigate the sources of heterogeneity.

**Participants** Studies reporting on the sources of LV experienced by nurses.

**Primary and secondary outcome measures** The main indicator was LV prevalence.

**Results** A total of 14 studies with 6,124 nurses were included in the systematic review. Further, thirteen articles with 5,745 nurses were included in the meta-analysis, and the pooled prevalence of LV among nurses was 33.08% (95%CI: 23.41%-42.75%, $P<0.05$; $I^2=99.0$%). The remaining one study containing 370 samples reported that the prevalence of inter-nurse LV was 7.92%. Subgroup analysis showed region, sample size, sampling, study’s quality, response rate and publication time might not be the sources of heterogeneity. Meta-regression indicated that sample size had the main influence on model heterogeneity. Egger’s test showed the existence of publication bias ($P=0.03$).

**Conclusion** The prevalence of inter-nurse LV is high in nurse workplace. It is suggested that scholars pay more attention to the cultural differences of inter-nurse LV between regions in the future.

**Keywords** prevalence; lateral violence; nurse workplace; meta-analysis

**Strengths and limitations of this study**

- The present systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.
- Subgroup analysis reported culture as the potential factor of lateral violence prevalence.
- The heterogeneity was explored by sensitivity, subgroup analysis and meta-regression analysis.
- Most of the studies included in the paper were from Asia, and lacked studies from Europe, Africa and other regions. The results were not representative of the global LV prevalence.

1. **Introduction**

Lateral violence (LV), which belongs to internal workplace violence, refers to inter-group conflict, manifested by sabotage, infighting, scapegoating, criticism and other explicit and implicit non-physical hostilities. It focuses on the negative behavior between peers with the same social status in the work environment, that is, the intimidation behavior between peers. Nursing profession
has the characteristics of heavy workload and cumbersome work content. Therefore, nurses are prone to psychological and physiological stress responses in such high-stress situations. When interacting with colleagues, they are likely to vent their dissatisfaction to colleagues, resulting in external violence or internal violence. Previous studies, which focused LV abusers on colleagues, nurses outside the department, and nursing managers, reported that LV is more common in nursing profession. It has been indicated that inter-nurse LV may have a negative impact on individual physical and mental health, such as causing nurses’ job burnout, post-traumatic stress disorder and other adverse consequences. In addition, LV among nurses may have a serious negative influence on the whole nursing team, increased turnover tendency of nurses and work burden of clinical nurses as examples. In terms of patient safety, it has been indicated that LV has an indirect effect on patient safety. Doo et al. through path model analysis, found that LV plays complete mediating role between the internalized dominant values and patient safety. In addition, due to the LV influenced them personally, created distraction or decreased their willingness to ask questions or for help, their ability to provide patient care was subsequently influenced negatively. That is, LV influences nurses’ physical and mental health, and patient safety, which seriously hinders the development of nursing profession. It must be given sufficient attention. Therefore, we need first understand the specific prevalence of inter-nurse LV in nurse workplace before developing and implementing interventions to improve this situation.

However, the results of the current studies reporting on the prevalence of LV in nurse workplace are inconsistent. One study from US reported that 85% nurses suffered from LV, while another study in the US indicated that about 22% of nurses reported been subjected to violence from their colleagues. Studies occurred in Korea showed that LV prevalence among nurses ranged from 11.5% to 40%. Another study from China reported that about 83% of neurologic nurses had suffered from inter-nurse LV. To date, no systematic review and meta-analysis has been published on synthesis of LV prevalence in nurse workplace. Therefore, the purpose of this review is to quantify the prevalence of LV prevalence among nurses in nurse workplace and to analyze whether there are differences in the LV prevalence among different regions.

2. Methods
This systematic review and meta-analysis was conducted on the basis of the preferred report items in the Preferred Reporting Items for Systemic Reviews and Meta-Analyses (PRISMA 2020) guidelines.

2.1. Search strategy

Articles related to the prevalence of LV in nurse workplace were retrieved from four English databases of Cochrane, PubMed, Embase and CINAHL and two Chinese databases of CNKI, Wanfang (from inception to January 27, 2021). Keywords used for searching were “lateral violence” (including “horizontal violence”, “horizontal hostility”, “bullying place”, “incivility”) and nurse, with the retrieval adjusted according to the database, the search strategy showed in Supplementary file 1. We also reviewed the list of references in the included studies to obtain additional studies.

2.2. Inclusion/Exclusion criteria

Inclusion criteria were that: (1) both abuser and victim were nurses; (2) articles reported the data of LV prevalence in nurse workplace; (3) LV was measured by self-report; (4) research design was cross-sectional, or case control, or cohort (using baseline data).

Exclusion criteria were: (1) meeting abstract, case reports, review, meta-analysis, letter, pilot study, qualitative study; (2) the abuser is not identified or the specific data of the abuser is not provided; (3) duplicate articles and/or data (When there are different articles in the same unit and the same sample, selected the most recent article.); (4) studies with unclear descriptions of nurse populations and events.

Two reviewers screened the literature independently according to the inclusion and exclusion criteria, and a third reviewer made judgment if there were conflicts.

2.3. Data extraction and quality assessment

Data was extracted independently by two investigators from eligible studies, and a third investigator cross-checked for accuracy. Data extracted included the first author, publication time, country, sample size, event (number of nurses subjected to LV), gender, age, measurement of LV, sampling, response rate, and prevalence of LV among nurses.

Quality of the included studies was evaluated using the modified Newcastle-Ottawa Scale (M-NOS). There are 5 items, with 1 point for each “Yes” answer and 0 point for each “No” answer.
The total score ranges from 0 to 5, with higher scores indicating better quality. In this study, ≥3 was defined as low-risk bias and <3 as high-risk bias.

2.4. Data analysis

Stata 16.0 was used for statistical analysis. Cochran's chi-square test (Cochran's Q value) and P value were adopted to assess heterogeneity, with P<0.05 or I²>50% indicating significant heterogeneity between studies. Fixed-effect model was performed to calculate the pooled prevalence of LV in nurse workplace when there was no significant heterogeneity, and random-effect model was used otherwise. Subgroup analysis, sensitivity analysis and meta-regression analysis were conducted to explore the sources of heterogeneity. Funnel plots and egger test were conducted to evaluate publication bias.

3. Result

3.1. Study selection

A total of 14 articles were included in this systematic review, involving 6,124 nurses. Sample size of the included studies ranged from 118 to 1,690. Among those studies, 13 were included in the meta-analysis, with the detailed showed in Figure 1.

3.2. Basic information of the included studies

In this systematic review, 3 researches occurred in the Americas,\textsuperscript{10,15,16} 10 in Asia\textsuperscript{4-6,11,12,17-20} and 1 in Europe.\textsuperscript{21} The prevalence of LV among nurses ranged from 6.83% to 82.68%. The lowest prevalence of LV was found in an American study and the highest in a study from China. With regard to the quality measured by M-NOS, 5 studies got <3 points and 9 researches got ≥3 points. Details are shown in Table 1(Table 1A and Table 1B).
| Study                  | Country      | Participants               | Sampling     | Response Rate | Sample Size | Gender (W:M) | Age (mean) | Nursing experience (%<5 years) | Quality Score |
|-----------------------|--------------|----------------------------|--------------|---------------|-------------|--------------|------------|---------------------------------|---------------|
| Vessey et al (2009)   | US           | Registered nurses          | Random       | 100%          | 303         | 289:14       | 49         | NA                              | 4             |
| Hampton et al (2019)  | US           | Nursing Leaders            | Convenience  | 1.8%          | 175         | 166:9        | 54         | NA                              | 2             |
| Pien et al (2019)     | China        | Nurses                     | Convenience  | 94.7%         | 1690        | 1690:0       | 33.4       | NA                              | 3             |
| Park et al (2015)     | South Korea  | Registered nurses          | Convenience  | 94.4%         | 970         | 970:0        | 28.6       | NA                              | 3             |
| Al-Surimi et al (2020)| Saudi Arabia | Nurses                     | Convenience  | 48.3%         | 519         | 922:152      | 38.77      | NA                              | 2             |
| Pai et al (2011)      | China        | Registered nurses          | Random       | 77.9%         | 521         | 498:23       | 36.2       | 20%                             | 4             |
| Rayan et al (2019)    | Saudi Arabia | Nurses                     | Random       | 98%           | 118         | 77:41        | 29.14      | NA                              | 2             |
| Difazio et al (2019)  | Russia       | Registered nurses          | Random       | 0.32%         | 438         | 392:10       | 20.56      | NA                              | 4             |
| Johnson et al (2009)  | US           | Registered nurses          | Random       | 32.5%         | 249         | 204:45       | 48.81      | NA                              | 4             |
| Chang et al (2016)    | Korea        | Registered nurses          | Convenience  | 44.01%        | 312         | 294:18       | 23.7       | NA                              | 3             |
| Li et al (2017)       | China        | Nurses                     | Convenience  | 95.77%        | 136         | 120:16       | NA         | 69.1%                           | 1             |
| Wang et al (2018)     | China        | Nurses                     | Convenience  | 94.4%         | 187         | 187:0        | 35.42      | 59.4%                           | 3             |
| Wu et al (2017)       | China        | Neurosurgery Nurses        | Convenience  | 100%          | 127         | 122:5        | 26.47      | 78%                             | 2             |
| Cheung et al (2017)   | China        | Nurses                     | Random       | 5.3%          | 850         | 745:105      | 34.44      | NA                              | 4             |

W: woman; M: man; NA: Not available
Table 1B LV-related characteristics of the 14 included studies

| Study                  | Measurement                                                                 | Event | Prevalence |
|------------------------|-----------------------------------------------------------------------------|-------|------------|
| Vessey et al (2009)    | A 30-item anonymous electronic survey was created in SurveyMonkey          | 31    | 0.10       |
| Hampton et al (2019)   | NAQ-R                                                                       | 38    | 0.22       |
| Pien et al (2019)      | A self-administered questionnaire was used to record the nurses’ experiences of workplace violence, including types (physical, psychological, verbal and sexual) and sources (internal and external) of violence | 228   | 0.13       |
| Park et al (2015)      | COPSOQ II                                                                  | 112   | 0.12       |
| Al-Surimi et al (2020) | It was sourced from an integrative literature review by Houck and Colbert. Responses to 15 themes were rated on a 5-point Likert scale | 186   | 0.36       |
| Pai et al (2011)       | WVQ                                                                         | 169   | 0.32       |
| Rayan et al (2019)     | The modified version of the Joint Programme on Workplace Violence in the Health Sector published by the International Labour Office | 21    | 0.18       |
| Difazio et al (2019)   | The Bullying in the Workplace 26-itemsurvey                                 | 79    | 0.18       |
| Johnson et al (2009)   | NAQ-R                                                                       | 17    | 0.07       |
| Chang et al (2016)     | COPSOQ II                                                                  | 125   | 0.40       |
| Li et al (2017)        | Lateral violence questionnaire compiled by Gao Yingying                     | 96    | 0.71       |
| Wang et al (2018)      | Lateral violence questionnaire compiled by Li XY                            | 135   | 0.72       |
| Wu et al (2017)        | SS                                                                          | 105   | 0.83       |
| Cheung et al (2017)    | Workplace violence in the health sector country case studies research instruments survey questionnaires"(English version) | 30    | 0.03       |

LV: lateral violence; NAQ-R: Revised Negative Acts Questionnaire; COPSOQ II: the second version of the medium-sized Copenhagen Psychosocial Questionnaire; WVQ: a Chinese-language version of the Workplace Violence Questionnaire; SS: sabotage savvy
3.3. Pooled prevalence of LV in nurse workplace

As sensitivity analysis showed that among the 14 eligible studies, one study had a great influence on the overall result, affected the stability, we eliminated this paper in the quantitative synthesis. Moreover, we qualitatively described this paper, that: This research published in 2017, was conducted by Cheung and Yip in Hong Kong, China, with a random sample of 370 nurses and response rate of 5.3% (Data was collected through the network). LV is measured by self-rating scale, and thirty of 370 had experienced inter-nurse LV, with the prevalence of 7.92%. The scale quality evaluation score was 4 points (Table 1A and Table 1B).

Finally, a total of 13 studies were included in the meta-analysis. The pooled prevalence of LV among nurses was 33.08% (95%CI: 23.41%-42.75%; \( I^2 =99.0\% \), \( P<0.001 \)) (Figure 2).

3.4. Subgroup analysis

Subgroup analysis showed that the pooled LV prevalence in Asian and non-Asian regions was 41.6% (95%CI: 27.9-55.4%) and 13.9% (95%CI: 7.6-20.1%), respectively (Q=13.01, \( P<0.001 \)). In the subgroup analysis of countries, the LV prevalence was 12.4% (95%CI: 5.5-19.3%) in the US, 54.2% (95%CI: 25.8-82.5%) in China, 25.7% (95%CI: -2.3-53.6%) in Korea, and 27% (95%CI: 9.4-44.7%) in Saudi Arabia (Q=10.03, \( P=0.040 \)). When the sample size was greater than 200, it was considered as large sample size, and the LV prevalence was 20.8% (95%CI: 14.0-27.7%), while in small sample size studies, it was 53.0% (95%CI: 25.7-80.3%) (Q=5.00, \( P=0.025 \)). Rate of LV prevalence in studies with random sampling was 17.0% (95%CI: 7.9-26.1%), significantly lower than that of convenience sampling of 43.3% (95%CI: 28.1-58.5%) (Q=8.46, \( P=0.004 \)). 2016 previously published research and published in 2016-2020 study rate of 15.2% (95%CI: 6.1-24.3%), 41.3% (95%CI: 25.8-56.7) (Q=8.13, \( P=0.004 \)). Additionally, researches with low quality reported higher LV prevalence than that of high quality (51.7% vs 24.9%). The LV prevalence in studies with response rate ≤50% was 24.4%, while in ≥50%, it was 38.6% (\( P=0.143 \)). However, none of the factors above might be a source of heterogeneity (Table 2).
Table 2 Subgroup analysis of the pooled prevalence

| Subgroup    | Studies | Pooled Prevalence (95%CI) | I² | Test of Difference within Each Subgroup |
|-------------|---------|---------------------------|----|----------------------------------------|
|             |         |                           |    | Q                                      | P         |
| Region      |         |                           |    |                                        |           |
| Asia        | 9       | 0.42(0.28,0.55)           | 99.2% | 13.01                                  | <0.001*** |
| Non-Asia    | 4       | 0.14(0.08,0.20)           | 90.6% |                                        |           |
| Country     |         |                           |    |                                        |           |
| US          | 3       | 0.12(0.05,0.19)           | 88.9% | 10.03                                  | 0.040*    |
| China       | 5       | 0.54(0.26,0.82)           | 99.5% |                                        |           |
| Korea       | 2       | 0.26(-0.02,0.54)          | 98.9% |                                        |           |
| Saudi Arabia| 2       | 0.27(0.09,0.45)           | 94.8% |                                        |           |
| Sample Size |         |                           |    |                                        |           |
| ≥200        | 8       | 0.21(0.14,0.28)           | 97.7% | 5.00                                  | 0.025*    |
| <200        | 5       | 0.53(0.26,0.80)           | 98.8% |                                        |           |
| Sampling    |         |                           |    |                                        |           |
| Random      | 5       | 0.17(0.08,0.26)           | 96.3% | 8.46                                  | 0.004**   |
| Convenience | 8       | 0.43(0.28,0.59)           | 99.3% |                                        |           |
| Quality Score|        |                           |    |                                        |           |
| High Risk   | 4       | 0.52(0.24,0.79)           | 98.8% | 3.31                                  | 0.069     |
| Low Risk    | 9       | 0.25(0.16,0.33)           | 98.4% |                                        |           |
| Response Rate|        |                           |    |                                        |           |
| <50%        | 5       | 0.24(0.12,0.37)           | 97.8% | 2.15                                  | 0.143     |
| ≥50%        | 8       | 0.39(0.24,0.53)           | 99.3% |                                        |           |
| Publication Time|        |                           |    |                                        |           |
| <2016       | 4       | 0.15(0.06,0.24)           | 97.3% | 8.13                                  | 0.004**   |
| 2016-2020   | 9       | 0.41(0.26,0.57)           | 99.1% |                                        |           |

P<0.05, P<0.01**, P<0.001***

3.5. Meta-regression analysis

Meta-regression was performed on region, sample size, sampling, quality score, response rate and publication time in the subgroup. The results showed that the prevalence of LV among nurses was higher in small sample studies (β=0.1176, P=0.016). In the result, sample size accounted for 80.48% of the overall heterogeneity. (Table 3)

Table 3 Meta-regression analyses of the effects of potential moderators

| Variables                  | B     | 95%CI Lower | 95%CI Upper | R²  | P value |
|----------------------------|-------|-------------|-------------|-----|---------|
| Region, Asia               | 0.1345| -0.0544     | 0.5376      | 19.31% | 0.100   |
| Sample Size, ≥200          | 0.1176| 0.0772      | 0.5949      | 80.48% | 0.016*  |
| Sampling, Random           | 0.1303| -0.638      | 0.5096      | 12.34% | 0.115   |
| Quality Score, High Risk   | 0.1391| -0.0259     | 0.5864      | 46.74% | 0.069   |
| Response Rate, <50%        | 0.1445| -0.4286     | 0.2071      | -13.10% | 0.460   |
| Publication Time, <2016    | 0.1309| -0.0529     | 0.5233      | 25.23% | 0.100   |

P<0.05*
Sensitivity analysis was conducted on the included 14 studies, and it was found that one article had a significant impact on the results (Figure 3). Therefore, this article was described separately. The left 13 studies were finally included in meta-analysis, and the result was unchanged by serially excluding each study (Figure 4). Funnel plots and egger's test indicated the existence of publication bias in the 13 studies ($P=0.003$) (Figure 5 & Figure 6).

4. Discussion

This systematic review included 14 studies with a total sample size of 6,124 nurses. The meta-analysis showed that the pooled prevalence of LV among nurses was 33.08% (95%CI: 23.41%-42.75%). According to existing research, this systematic review and meta-analysis is the first to synthesis the prevalence of LV in nurse workplace worldwide.

Subgroup analysis revealed that there were significant differences in the overall prevalence of LV in Asia and non-Asian regions. The prevalence of LV in Asia (41.6%) is higher than that of non-Asian LV (13.9%). The possible reason may be that Asian and non-Asian cultural backgrounds are different, leading to differences in their understanding and handling of LV. In the context of collectivism in Japan, South Korea, and other Asian countries, harmony and group norms are more valuable, which may lead to differences in the definition of LV between the collectivist cultural background and the Western cultural background. To explore whether the LV prevalence was related to cultural differences, the region subgroup was divided into country subgroup for analysis, which showed significant differences. From the analysis of LV prevalence, among the four countries, the United States has the lowest LV prevalence, while China has the highest. Therefore, LV may be related to cultural differences in different countries, but currently there are only a few included studies, lacking studies in Europe, Australia, Africa and other countries. It is recommended to carry out studies on LV prevalence among nurses in more regions in the future.

The result showed significant differences in LV prevalence between different sampling methods and sample sizes. In order to facilitate sampling, participants from one or several departments are usually selected for research, but there are differences in LV prevalence between departments and different working environments. The working environment and atmosphere of the selected personnel lack universality, resulting in differences between different sampling methods. With regard to sample size, it has been shown that in studies with smaller
participants, due to selection bias and publication bias, more extreme prevalence estimates tend to be obtained. Therefore, researchers should be more cautious when analyzing the impact of sample size and sampling method on prevalence.

Chen et al summarized and analyzed the research published by LV and found that the number of articles published before 2014 was less than 10, but it started to increase after 2015. Compared with other research fields, this may be related to the fact that this field is a new field. The development time of this field is not very long, the early stage is still in the exploratory stage, the research is not deep enough, and a large number of theoretical and practical explorations have begun in the later stage. Therefore, this study uses 2015 as the time point for observing the difference in prevalence. Subgroup analysis shows that the prevalence of LV varies at different publication times. The higher prevalence of LV reported after 2016 may be related to the fact that society has begun to attach importance to the concept of LV and has increased people's self-protection awareness after 2016. For the studies included in the meta-analysis, the prevalence of the three studies all exceeded 70%, all of which were from China and were published after 2016. The second study is from South Korea, both of which are developing countries in Asia. It is estimated that in developed countries in Europe and America, the total prevalence of LV is about 14%, which is very different. It is recommended that future studies consider comparing the LV prevalence between developing and developed countries.

Among all the included Chinese studies, this single analysis had the lowest LV prevalence. Their analysis of the results believes that it has something to do with the nurse's attitude. They thought report violent behavior will not change anything. It is similar to the attitude of subjects in an empirical analysis study on how to deal with workplace bullying. This attitude may make nurses choose to endure silently, leading to insufficient reporting, resulting in measured values lower than true values, which can explain the low response rate. The results also show that unhappiness among colleagues is an important factor in workplace LV. It is suggested that the occurrence of LV may be related to a stressful environment, such as the zero tolerance attitude of the Hong Kong health department towards nursing negligence and media public opinion. Nurses are afraid of being blamed for jeopardizing their careers, are unwilling to help colleagues, and lack team cohesion. The formal nurses or old nurses are easy to despise or attack other nurses. The tedious and high-pressure work
will make nurses prone to physical and mental exhaustion. If they are subjected to LV again, their physical and mental health and work (Efficiency and performance) will be affected. And further affect the nursing team atmosphere and quality have a negative impact, so nurses under this pressure may cause the occurrence of LV.

When looking for sources of heterogeneity, subgroup analysis suggested that each subgroup variable we set was not a source of heterogeneity; and meta-regression showed that sample size might be a source of heterogeneity. Sensitivity analysis of 14 articles showed that one study would affect the overall research results. Sensitivity analysis was conducted again after removing this paper, and the results showed the stability. There was publication bias in this meta-analysis, which may exaggerate the results of this study. Therefore, it is necessary to be more rigorous in the generalization of the conclusion.

The study showed the high level of LV, which should be paid attention to by nursing managers. Through the analysis, it is concluded that culture may cause the difference in nurses' perception of LV. In the future, researchers can focus on cultural differences to further explore and find effective intervention measures, so as to improve the adverse effects of LV on nurses' physical and mental health and patient safety. This study has the following limitations. Firstly, more than half of the studies included were in countries in the Asian region, and many countries lacked studies on prevalence of LV, so this result may not be completely representative of the global level. Taking into account the inconsistent cultural background due to the medical environment in different regions, we recommended that more studies about LV in nurse workplace be carried out in different regions to understand the overall situation. Secondly, while we have excluded studies that did not define and measure descriptions, and where the description of the perpetrator was unclear, inconsistencies are still inevitable. That is, the measurement of LV in this systematic review and meta-analysis were all self-report, self-designed and self-administered questionnaires, which may lead to subjective and inconsistent data reports, as no standard assessment tool existed. Therefore, it is suggested that a standard, comprehensive and objective evaluation tool should be developed to measure LV in the future. Finally, no grey literature was searched. We focused on LV prevalence worldwide. Considering the difficulty of searching grey literature in various regions and the fact that some grey literature may have been converted to published studies over time, it increases the
complexity of subsequent screening data. However, LV problem is sensitive, and the data of grey literature may explain some problems. Therefore, it is suggested that scholars pay attention to the screening of grey literature in the future.

5. Conclusion

The prevalence of LV in nurse workplace is high, with the rate of 33.08%. In addition, the analysis of this study showed, there are differences in LV prevalence among different regions, possibly influenced by cultural environment. But lack of sufficient evidence to support. It is suggested to further explore LV in terms of cultural differences in the future.

Patient and public involvement
No patient involved.

Contributorship statement
YZ and JC searched and checked the databases according to the inclusion and exclusion criteria, extracted the data and assessed their quality. YZ analyzed the data and wrote the draft of the paper. SQ, RY, JC, HW and XS gave advice on meta-analysis methodology and revised the paper. All authors contributed to reviewing or revising the paper. LM is the guarantors of this work and had full access to all the data in the study and take responsibility for its integrity and the accuracy of the data analysis. All authors read and approved the final manuscript.

Competing interests
The authors declare that they have no conflict of interest.

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Data sharing statement
No additional data available.

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Legends

Figure 1 Screening flow chart
Figure 2 Forest plot of eligible studies
Figure 3 Sensitivity analysis estimating heterogeneity
Figure 4 Sensitivity analysis estimating heterogeneity
Figure 5 Funnel plots estimating small sample bias
Figure 6 Egger’s test estimating publication bias
Supplementary file 1 Search strategy
Figure 1 Screening flow chart

Records identified through database searching:
PUBMED (404), Cochrane (24), CINAHL (15), Embase (312), Wanfang (55), CNKI (47)
(n=937)

Records after duplicates removed (n=510)

Records screened (n=114)

Records excluded (n=396)

Full-text articles assessed for eligibility (n=14)

Studies included in qualitative synthesis (n=14)

Full-text articles excluded with reasons (n=100)
1. the abuser is not identified or the specific date of the abuser is not provided (n=23)
2. studies with unclear descriptions of nurse populations and events (n=76)
3. duplicate articles and/or data (n=1)

Studies included in quantitative synthesis (meta-analysis) (n=13)
| Study ID          | n  | event | Effect (95% CI) | Weight |
|------------------|----|-------|-----------------|--------|
| Vessey et al (2009) | 303 | 31    | 0.10 (0.07, 0.14) | 7.78   |
| Hampton et al (2019) | 175 | 39    | 0.22 (0.16, 0.29) | 7.62   |
| Pien et al (2015) | 1690 | 228  | 0.13 (0.12, 0.15) | 7.84   |
| Park et al (2015) | 970  | 112   | 0.12 (0.10, 0.14) | 7.83   |
| Al-Surimi et al (2020) | 519 | 186   | 0.36 (0.32, 0.40) | 7.74   |
| Pai et al (2011) | 521  | 169   | 0.32 (0.28, 0.36) | 7.75   |
| Rayan et al (2019) | 116  | 21    | 0.18 (0.11, 0.25) | 7.55   |
| Difazio et al (2019) | 438 | 79    | 0.18 (0.14, 0.22) | 7.77   |
| Johnson et al (2009) | 249 | 17    | 0.07 (0.04, 0.10) | 7.79   |
| Chang et al (2016) | 312  | 125   | 0.40 (0.35, 0.46) | 6.67   |
| Li et al (2017) | 136  | 96    | 0.71 (0.63, 0.78) | 4.49   |
| Wang et al (2018) | 197  | 138   | 0.72 (0.66, 0.79) | 7.59   |
| Wu et al (2017) | 127  | 106   | 0.83 (0.76, 0.89) | 7.58   |
| Overall, DL (I² = 99.0%, p = 0.000) | | | 0.33 (0.23, 0.43) | 100.00 |

**Note:** Weights are from random-effects model

**Figure 2 Forest plot of eligible studies**

273x199mm (300 x 300 DPI)
Figure 3 Sensitivity analysis estimating heterogeneity

301x201mm (300 x 300 DPI)
Figure 4 Sensitivity analysis estimating heterogeneity

301x201mm (300 x 300 DPI)
Figure 5 Funnel plots estimating small sample bias

209x152mm (300 x 300 DPI)
Figure 6 Egger’s test estimating publication bias

209x152mm (300 x 300 DPI)
Supplementary file 1: Search strategy

PubMed/Cochrane/CNKI/Wanfang:
(lateral violence OR horizontal violence OR horizontal hostility OR bullying OR workplace incivility) And nurse.

CINAHL:
(lateral violence OR horizontal violence OR horizontal hostility OR bullying OR workplace incivility) And nurse And English language.

Embase:
(lateral violence OR horizontal violence OR horizontal hostility OR bullying OR workplace incivility) And nurse And humans And English language.
Meta-analysis of observational studies in epidemiology: a proposal for reporting.  
Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group

| Reporting guideline provided for? | Meta-analysis and Systematic review of observational studies in epidemiology |
|----------------------------------|--------------------------------------------------------------------------------|
| (i.e.exactly what the authors state in the paper) | |
| Full bibliographic reference     | Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, Moher D, Becker BJ, Sipe TA, Thacker SB. Meta-analysis of observational studies in epidemiology: a proposal for reporting. Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group. JAMA. 2000; 283(15):2008-2012. |
| Language                         | English |
| PubMed ID                        | 10789670 |
| Reporting guideline acronym      | MOOSE |
| Study design                     | Meta analyses/Systematic reviews |
| Clinical area                    | Public health |
| Applies to the whole report or to individual sections of the report? | Whole report |
| Record last updated on           | December 4, 2021 |
| Section and Topic | Item # | Checklist item | Location where item is reported |
|------------------|--------|---------------|---------------------------------|
| TITLE | 1 | Identify the report as a systematic review. | 1 |
| ABSTRACT | 2 | See the PRISMA 2020 for Abstracts checklist. | 1-2 |
| INTRODUCTION | 3 | Describe the rationale for the review in the context of existing knowledge. | 2-3 |
| Objectives | 4 | Provide an explicit statement of the objective(s) or question(s) the review addresses. | 3 |
| METHODS | 5 | Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses. | 4 |
| Eligibility criteria | 6 | Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted. | 4 |
| Information sources | 7 | Present the full search strategies for all databases, registers and websites, including any filters and limits used. | 4 |
| Search strategy | 8 | Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process. | 4 |
| Selection process | 9 | Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process. | 4 |
| Data collection process | 10a | List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect. | 4 |
| Data items | 10b | List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information. | 4 |
| Study risk of bias assessment | 11 | Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process. | 5 |
| Effect measures | 12 | Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results. | 5 |
| Synthesis methods | 13a | Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)). | 5 |
| 13b | Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions. | 5 |
| 13c | Describe any methods used to tabulate or visually display results of individual studies and syntheses. | 5 |
| 13d | Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used. | 5 |
| 13e | Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression). | 5 |
| 13f | Describe any sensitivity analyses conducted to assess robustness of the synthesized results. | 5 |
| Reporting bias assessment | 14 | Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases). | 5 |
| Certainty assessment | 15 | Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome. | 5 |
| Section and Topic | Item | Checklist item | Location where item is reported |
|------------------|------|----------------|----------------------------------|
| RESULTS          | 16a  | Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram. | 5 |
|                  | 16b  | Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded. | 5 |
|                  | 17   | Cite each included study and present its characteristics. | 8 |
|                  | 18   | Present assessments of risk of bias for each included study. | 9-10 |
|                  | 19   | For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots. | 6-7 |
|                  | 20a  | For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies. | 8-9 |
|                  | 20b  | Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect. | 8-9 |
|                  | 20c  | Present results of all investigations of possible causes of heterogeneity among study results. | 9-10 |
|                  | 20d  | Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results. | 10 |
|                  | 21   | Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed. | 10 |
|                  | 22   | Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed. | 8-9 |
| DISCUSSION       | 23a  | Provide a general interpretation of the results in the context of other evidence. | 10-12 |
|                  | 23b  | Discuss any limitations of the evidence included in the review. | 12-13 |
|                  | 23c  | Discuss any limitations of the review processes used. | 12-13 |
|                  | 23d  | Discuss implications of the results for practice, policy, and future research. | 12 |
| OTHER INFORMATION| 24a  | Provide registration information for the review, including register name and registration number, or state that the review was not registered. | NA |
|                  | 24b  | Indicate where the review protocol can be accessed, or state that a protocol was not prepared. | NA |
|                  | 24c  | Describe and explain any amendments to information provided at registration or in the protocol. | NA |
|                  | 25   | Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review. | 13 |
|                  | 26   | Declare any competing interests of review authors. | 13 |
|                  | 27   | Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review. | 13 |
### Prevalence of Lateral Violence in Nurse Workplace: A Systematic Review and Meta-analysis

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Prevalence of Lateral Violence in Nurse Workplace: A Systematic Review and Meta-analysis

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Abstract

Background The prevalence of inter-nurse lateral violence (LV) reported in current studies is inconsistent, ranging from 7% to 83%. The purpose of this study is to quantify the prevalence of LV in nurses’ workplaces.

Methods Systematic review and meta-analysis. Cochrane, PubMed, Embase, CINAHL, CNKI and Wanfang databases were searched for relevant studies (up to January 27, 2021). We included cross-sectional, case-control, or cohort studies in which both abusers and victims were nurses. Studies that didn’t provide specific data on abusers were excluded. Stata 16.0 was used for statistical
analysis. Fixed-effect or random-effect model was adopted according to heterogeneity which was evaluated by Cochran’s $Q$ and $I^2$ values. The main indicator was LV prevalence. Sensitivity analysis, subgroup analysis and meta-regression were performed to investigate the sources of heterogeneity.

**Results** A total of 14 studies with 6,124 nurses were included. Further, thirteen articles with 5,745 nurses were included in the meta-analysis, and the pooled prevalence of LV among nurses was 33.08% (95%CI: 23.41%-42.75%, $P<0.05$; $I^2=99.0$%). The remaining one study containing 370 samples reported that the prevalence of inter-nurse LV was 7.92%. Subgroup analysis showed region, sample size, sampling, study's quality, response rate and publication time might not be the sources of heterogeneity. Meta-regression indicated that sample size had the main influence on model heterogeneity. Egger’s test showed the existence of publication bias ($P=0.03$).

**Discussion** The prevalence of inter-nurse LV is high in nurse workplace. It is suggested that scholars pay more attention to the cultural differences of inter-nurse LV between regions in the future. This study has the following limitations: There is a lack of studies on LV prevalence in many countries. Lacking standard assessment tools. No grey literature was searched.

**Other** This study was supported by the National Natural Science Foundation of China (Grant No.71874117) and not registered.

**Keywords** prevalence; lateral violence; nurse workplace; meta-analysis

**Strengths and limitations of this study**

- The present systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.
- Subgroup analysis reported culture as the potential factor of lateral violence prevalence.
- The heterogeneity was explored by sensitivity, subgroup analysis and meta-regression analysis.
- Most of the studies included in the paper were from Asia, and lacked studies from Europe, Africa and other regions. The results were not representative of the global LV prevalence.

**1. Introduction**

Lateral violence (LV), which belongs to internal workplace violence, refers to inter-group conflict, manifested by sabotage, infighting, scapegoating, criticism and other explicit and implicit
non-physical hostilities.\textsuperscript{1} It focuses on the negative behavior between peers with the same social status in the work environment, that is, the intimidation behavior between peers.\textsuperscript{1} Nursing profession has the characteristics of heavy workload and cumbersome work content. Therefore, nurses are prone to psychological and physiological stress responses in such high-stress situations. When interacting with colleagues, they are likely to vent their dissatisfaction to colleagues, resulting in external violence or internal violence.\textsuperscript{1} Previous studies, which focused LV abusers on colleagues, nurses outside the department, and nursing managers, reported that LV is more common in nursing profession. It has been indicated that inter-nurse LV may have a negative impact on individual physical and mental health, such as causing nurses’ job burnout, post-traumatic stress disorder and other adverse consequences. In addition, LV among nurses may have a serious negative influence on the whole nursing team, increased turnover tendency of nurses and work burden of clinical nurses as examples.\textsuperscript{2, 4-6} In terms of patient safety, it has been indicated that LV has an indirect effect on patient safety.\textsuperscript{7, 8} Doo et al\textsuperscript{7} through path model analysis, found that LV plays complete mediating role between the internalized dominant values and patient safety. In addition, due to the LV influenced them personally, created distraction or decreased their willingness to ask questions or for help, their ability to provide patient care was subsequently influenced negatively.\textsuperscript{8} That is, LV influences nurses’ physical and mental health, and patient safety, which seriously hinders the development of nursing profession. It must be given sufficient attention. Therefore, we need first understand the specific prevalence of inter-nurse LV in nurse workplace before developing and implementing interventions to improve this situation.

However, the results of the current studies reporting on the prevalence of LV in nurse workplace are inconsistent. One study from US reported that 85% nurses suffered from LV,\textsuperscript{9} while another study in the US indicated that about 22% of nurses reported been subjected to violence from their colleagues.\textsuperscript{10} Studies occurred in Korea showed that LV prevalence among nurses ranged from 11.5% to 40%.\textsuperscript{11, 12} Another study from China reported that about 83% of neurologic nurses had suffered from inter-nurse LV.\textsuperscript{13} To date, no systematic review and meta-analysis has been published on synthesis of LV prevalence in nurse workplace. Therefore, the purpose of this review is to quantify the prevalence of LV prevalence among nurses in nurse workplace and to analyze whether there are differences in the LV prevalence among different regions.
2. Methods

This systematic review and meta-analysis was conducted on the basis of the preferred report items in the Preferred Reporting Items for Systemic Reviews and Meta-Analyses (PRISMA 2020) guidelines.

2.1. Search strategy

Articles related to the prevalence of LV in nurse workplace were retrieved from four English databases of Cochrane, PubMed, Embase and CINAHL and two Chinese databases of CNKI, Wanfang (from inception to January 27, 2021). Keywords used for searching were “lateral violence” (including “horizontal violence”, “horizontal hostility”, “bullying place”, “incivility”) and nurse, with the retrieval adjusted according to the database, the search strategy showed in Supplementary file 1. We also reviewed the list of references in the included studies to obtain additional studies.

2.2. Inclusion/Exclusion criteria

Inclusion criteria were that: (1) both abuser and victim were nurses; (2) articles reported the data of LV prevalence in nurse workplace; (3) LV was measured by self-report; (4) research design was cross-sectional, or case control, or cohort (using baseline data).

Exclusion criteria were: (1) meeting abstract, case reports, review, meta-analysis, letter, pilot study, qualitative study; (2) the abuser is not identified or the specific data of the abuser is not provided; (3) duplicate articles and/or data (When there are different articles in the same unit and the same sample, selected the most recent article.); (4) studies with unclear descriptions of nurse populations and events.

Two reviewers screened the literature independently according to the inclusion and exclusion criteria, and a third reviewer made judgment if there were conflicts.

2.3. Data extraction and quality assessment

Data was extracted independently by two investigators from eligible studies, and a third investigator cross-checked for accuracy. Data extracted included the first author, publication time, country, sample size, event (number of nurses subjected to LV), gender, age, measurement of LV, sampling, response rate, and prevalence of LV among nurses.

Quality of the included studies was evaluated using the modified Newcastle-Ottawa Scale (M-NOS). There are 5 items, with 1 point for each "Yes" answer and 0 point for each "No" answer.
The total score ranges from 0 to 5, with higher scores indicating better quality. In this study, ≥3 was defined as low-risk bias and <3 as high-risk bias.

2.4. Data analysis

Stata 16.0 was used for statistical analysis. Cochran's chi-square test (Cochran's Q value) and P value were adopted to assess heterogeneity, with \( P < 0.05 \) or \( P > 50\% \) indicating significant heterogeneity between studies. Fixed-effect model was performed to calculate the pooled prevalence of LV in nurse workplace when there was no significant heterogeneity, and random-effect model was used otherwise. Subgroup analysis, sensitivity analysis and meta-regression analysis were conducted to explore the sources of heterogeneity. Funnel plots and egger test were conducted to evaluate publication bias.

3. Result

3.1. Study selection

A total of 14 articles were included in this systematic review, involving 6,124 nurses. Sample size of the included studies ranged from 118 to 1,690. Among those studies, 13 were included in the meta-analysis, with the detailed showed in Figure 1.

3.2. Basic information of the included studies

In this systematic review, 3 researches occurred in the Americas, \(^{10,15,16}\) 10 in Asia \(^{4-6,11,12,17-20}\) and 1 in Europe. \(^{21}\) The prevalence of LV among nurses ranged from 6.83% to 82.68%. The lowest prevalence of LV was found in an American study and the highest in a study from China. With regard to the quality measured by M-NOS, 5 studies got <3 points and 9 researches got ≥3 points. Details are shown in Table 1(Table 1A and Table 1B).
| Study                  | Country      | Participants          | Sampling        | Response Rate | Sample Size | Gender (W:M) | Age (mean) | Nursing experience (%<5 years) | Quality Score |
|-----------------------|--------------|-----------------------|-----------------|---------------|-------------|--------------|------------|--------------------------------|---------------|
| Vessey et al (2009)   | US           | Registered nurses     | Random          | 100%          | 303         | 289:14       | 49         | NA                             | 4             |
| Hampton et al (2019)  | US           | Nursing Leaders       | Convenience     | 1.8%          | 175         | 166:9        | 54         | NA                             | 2             |
| Pien et al (2019)     | China        | Nurses                | Convenience     | 94.7%         | 1690        | 1690:0       | 33.4       | NA                             | 3             |
| Park et al (2015)     | South Korea  | Registered nurses     | Convenience     | 94.4%         | 970         | 970:0        | 28.6       | NA                             | 3             |
| Al-Surimi et al       | Saudi Arabia | Nurses                | Convenience     | 48.3%         | 519         | 922:152      | 38.77      | NA                             | 2             |
| Pai et al (2011)      | China        | Registered nurses     | Random          | 77.9%         | 521         | 498:23       | 36.2       | 20%                            | 4             |
| Rayan et al (2019)    | Saudi Arabia | Nurses                | Random          | 98%           | 118         | 77:41        | 29.14      | NA                             | 2             |
| Difazio et al (2019)  | Russia       | Registered nurses     | Random          | 0.32%         | 438         | 392:10       | 20.56      | NA                             | 4             |
| Johnson et al (2009)  | US           | Registered nurses     | Random          | 32.5%         | 249         | 204:45       | 48.81      | NA                             | 4             |
| Chang et al (2016)    | Korea        | Registered nurses     | Convenience     | 44.01%        | 312         | 294:18       | 23.7       | NA                             | 3             |
| Li et al (2017)       | China        | Nurses                | Convenience     | 95.77%        | 136         | 120:16       | NA         | 69.1%                          | 1             |
| Wang et al (2018)     | China        | Nurses                | Convenience     | 94.4%         | 187         | 187:0        | 35.42      | 59.4%                          | 3             |
| Wu et al (2017)       | China        | Neurosurgery Nurses   | Convenience     | 100%          | 127         | 122:5        | 26.47      | 78%                            | 2             |
| Cheung et al (2017)   | China        | Nurses                | Random          | 5.3%          | 850         | 745:105      | 34.44      | NA                             | 4             |

W: woman; M: man; NA: Not available
| Study                  | Measurement                                                                 | Event | Prevalence |
|-----------------------|------------------------------------------------------------------------------|-------|------------|
| Vessey et al (2009)   | A 30-item anonymous electronic survey was created in SurveyMonkey          | 31    | 0.10       |
| Hampton et al (2019)  | NAQ-R                                                                         | 38    | 0.22       |
| Pien et al (2019)     | A self-administered questionnaire was used to record the nurses’ experiences of workplace violence, including types (physical, psychological, verbal and sexual) and sources (internal and external) of violence | 228   | 0.13       |
| Park et al (2015)     | COPSOQ II                                                                     | 112   | 0.12       |
| Al-Surimi et al (2020)| It was sourced from an integrative literature review by Houck and Colbert. Responses to 15 themes were rated on a 5-point Likert scale | 186   | 0.36       |
| Pai et al (2011)      | WVQ                                                                           | 169   | 0.32       |
| Rayan et al (2019)    | The modified version of the Joint Programme on Workplace Violence in the Health Sector published by the International Labour Office | 21    | 0.18       |
| Difazio et al (2019)  | The Bullying in the Workplace 26-itemsurvey                                   | 79    | 0.18       |
| Johnson et al (2009)  | NAQ-R                                                                         | 17    | 0.07       |
| Chang et al (2016)    | COPSOQ II                                                                     | 125   | 0.40       |
| Li et al (2017)       | Lateral violence questionnaire compiled by Gao Yingying                      | 96    | 0.71       |
| Wang et al (2018)     | Lateral violence questionnaire compiled by Li XY                              | 135   | 0.72       |
| Wu et al (2017)       | SS                                                                            | 105   | 0.83       |
| Cheung et al (2017)   | Workplace violence in the health sector country case studies research instruments survey questionnaires”(English version) | 30    | 0.03       |

LV: lateral violence; NAQ-R: Revised Negative Acts Questionnaire; COPSOQ II: the second version of the medium-sized Copenhagen Psychosocial Questionnaire; WVQ: a Chinese-language version of the Workplace Violence Questionnaire; SS: sabotage savvy
3.3. Pooled prevalence of LV in nurse workplace

As sensitivity analysis showed that among the 14 eligible studies, one study\textsuperscript{20} had a great
influence on the overall result, affected the stability, we eliminated this paper in the quantitative
synthesis. Moreover, we qualitatively described this paper, that: This research published in 2017,
was conducted by Cheung and Yip in Hong Kong, China, with a random sample of 370 nurses and
response rate of 5.3\% (Data was collected through the network). LV is measured by self-rating scale,
and thirty of 370 had experienced inter-nurse LV, with the prevalence of 7.92\%. The scale quality
evaluation score was 4 points (Table 1A and Table 1B).

Finally, a total of 13 studies were included in the meta-analysis. The pooled prevalence of
LV among nurses was 33.08\% (95\%CI: 23.41\%-42.75\%; \(I^2=99.0\%, P<0.001\)) (Figure 2).

3.4. Subgroup analysis

Subgroup analysis showed that the pooled LV prevalence in Asian and non-Asian regions
was 41.6\% (95\%CI: 27.9-55.4\%) and 13.9\% (95\%CI: 7.6-20.1\%), respectively (\(Q=13.01, P<0.001\)).
In the subgroup analysis of countries, the LV prevalence was 12.4\% (95\%CI: 5.5-19.3\%) in the US,
54.2\% (95\%CI: 25.8-82.5\%) in China, 25.7\% (95\%CI: -2.3-53.6\%) in Korea, and 27\% (95\%CI:
9.4-44.7\%) in Saudi Arabia (\(Q=10.03, P=0.040\)). When the sample size was greater than 200, it was
considered as large sample size, and the LV prevalence was 20.8\% (95\%CI: 14.0-27.7\%), while in
small sample size studies, it was 53.0\% (95\%CI: 25.7-80.3\%) (\(Q=5.00, P=0.025\)). Rate of LV
prevalence in studies with random sampling was 17.0\% (95\%CI: 7.9-26.1\%), significantly lower
than that of convenience sampling of 43.3\% (95\%CI: 28.1-58.5\%) (\(Q=8.46, P=0.004\)). 2016
previously published research and published in 2016-2020 study rate of 15.2\% (95\%CI: 6.1-24.3\%)
41.3\% (95\%CI: 25.8-56.7) (\(Q=8.13, P=0.004\)). Additionally, researches with low quality reported
higher LV prevalence than that of high quality (51.7\% vs 24.9\%). The LV prevalence in studies
with response rate <50\% was 24.4\%, while in \(\geq50\%\), it was 38.6\% (\(P=0.143\)). However, none of
the factors above might be a source of heterogeneity (Table 2).
Table 2 Subgroup analysis of the pooled prevalence

| Subgroup   | Studies | Pooled Prevalence (95%CI) | I² | Test of Difference within Each Subgroup |
|------------|---------|---------------------------|----|----------------------------------------|
| Region     |         |                           |    |                                        |
| Asia       | 9       | 0.42(0.28,0.55)           | 99.2% | Q=13.01 | $P<0.001^{***}$ |
| Non-Asia   | 4       | 0.14(0.08,0.20)           | 90.6% |                                      |
| Country    |         |                           |    |                                        |
| US         | 3       | 0.12(0.05,0.19)           | 88.9% | Q=10.03 | $P=0.040^*$ |
| China      | 5       | 0.54(0.26,0.82)           | 99.5% |                                      |
| Korea      | 2       | 0.26(-0.02,0.54)          | 98.9% |                                      |
| Saudi Arabia | 2   | 0.27(0.09,0.45)           | 94.8% |                                      |
| Sample Size|         |                           |    |                                        |
| ≥200       | 8       | 0.21(0.14,0.28)           | 97.7% | Q=5.00 | $P=0.025^*$ |
| <200       | 5       | 0.53(0.26,0.80)           | 98.8% |                                      |
| Sampling   |         |                           |    |                                        |
| Random     | 5       | 0.17(0.08,0.26)           | 96.3% | Q=8.46 | $P=0.004^{**}$ |
| Convenience| 8       | 0.43(0.28,0.59)           | 99.3% |                                      |
| Quality Score|      |                           |    |                                        |
| High Risk  | 4       | 0.52(0.24,0.79)           | 98.8% | Q=3.31 | 0.069 |
| Low Risk   | 9       | 0.25(0.16,0.33)           | 98.4% |                                      |
| Response Rate|       |                           |    |                                        |
| <50%       | 5       | 0.24(0.12,0.37)           | 97.8% | Q=2.15 | 0.143 |
| ≥50%       | 8       | 0.39(0.24,0.53)           | 99.3% |                                      |
| Publication Time|   |                           |    |                                        |
| <2016      | 4       | 0.15(0.06,0.24)           | 97.3% | Q=8.13 | $P=0.004^{**}$ |
| 2016-2020  | 9       | 0.41(0.26,0.57)           | 99.1% |                                      |

$P<0.05^*, P<0.01^{**}, P<0.001^{***}$

3.5. Meta-regression analysis

Meta-regression was performed on region, sample size, sampling, quality score, response rate and publication time in the subgroup. The results showed that the prevalence of LV among nurses was higher in small sample studies ($\beta=0.1176, P=0.016$). In the result, sample size accounted for 80.48% of the overall heterogeneity. (Table 3)

Table 3 Meta-regression analyses of the effects of potential moderators

| Variables                              | B     | 95%CI          | R²    | $P$ value |
|----------------------------------------|-------|----------------|-------|-----------|
|                                        |       | Lower | Upper   |           |           |
| Region, Asia                           | 0.1345| -0.0544| 0.5376 | 19.31%    | 0.100     |
| Sample Size, ≥200                      | 0.1176| 0.0772 | 0.5949 | 80.48%    | 0.016*    |
| Sampling, Random                       | 0.1303| -0.638 | 0.5096 | 12.34%    | 0.115     |
| Quality Score, High Risk               | 0.1391| -0.0259| 0.5864 | 46.74%    | 0.069     |
| Response Rate, <50%                    | 0.1445| -0.4286| 0.2071 | -13.10%   | 0.460     |
| Publication Time, <2016                 | 0.1309| -0.0529| 0.5233 | 25.23%    | 0.100     |

$P<0.05^*$

3.6. Sensitivity analysis and publication bias
Sensitivity analysis was conducted on the included 14 studies, and it was found that one article had a significant impact on the results (Figure 3). Therefore, this article was described separately. The left 13 studies were finally included in meta-analysis, and the result was unchanged by serially excluding each study (Figure 4). Funnel plots and egger's test indicated the existence of publication bias in the 13 studies ($P=0.003$) (Figure 5 & Figure 6).

4. Discussion

This systematic review included 14 studies with a total sample size of 6,124 nurses. The meta-analysis showed that the pooled prevalence of LV among nurses was 33.08% (95%CI: 23.41%-42.75%). According to existing research, this systematic review and meta-analysis is the first to synthesis the prevalence of LV in nurse workplace worldwide.

Subgroup analysis revealed that there were significant differences in the overall prevalence of LV in Asia and non-Asian regions. The prevalence of LV in Asia (41.6%) is higher than that of non-Asian LV (13.9%). The possible reason may be that Asian and non-Asian cultural backgrounds are different, leading to differences in their understanding and handling of LV. In the context of collectivism in Japan, South Korea, and other Asian countries, harmony and group norms are more valuable, which may lead to differences in the definition of LV between the collectivist cultural background and the Western cultural background. To explore whether the LV prevalence was related to cultural differences, the region subgroup was divided into country subgroup for analysis, which showed significant differences. From the analysis of LV prevalence, among the four countries, the United States has the lowest LV prevalence, while China has the highest. Therefore, LV may be related to cultural differences in different countries, but currently there are only a few included studies, lacking studies in Europe, Australia, Africa and other countries. It is recommended to carry out studies on LV prevalence among nurses in more regions in the future.

The result showed significant differences in LV prevalence between different sampling methods and sample sizes. In order to facilitate sampling, participants from one or several departments are usually selected for research, but there are differences in LV prevalence between departments and different working environments. The working environment and atmosphere of the selected personnel lack universality, resulting in differences between different sampling methods. With regard to sample size, it has been shown that in studies with smaller
participants, due to selection bias and publication bias, more extreme prevalence estimates tend to be obtained.\textsuperscript{25} Therefore, researchers should be more cautious when analyzing the impact of sample size and sampling method on prevalence.

Chen et al\textsuperscript{1} summarized and analyzed the research published by LV and found that the number of articles published before 2014 was less than 10, but it started to increase after 2015. Compared with other research fields, this may be related to the fact that this field is a new field. The development time of this field is not very long, the early stage is still in the exploratory stage, the research is not deep enough, and a large number of theoretical and practical explorations have begun in the later stage. Therefore, this study uses 2015 as the time point for observing the difference in prevalence. Subgroup analysis shows that the prevalence of LV varies at different publication times. The higher prevalence of LV reported after 2016 may be related to the fact that society has begun to attach importance to the concept of LV and has increased people's self-protection awareness after 2016. For the studies included in the meta-analysis, the prevalence of the three studies all exceeded 70\%, all of which were from China and were published after 2016. The second study is from South Korea, both of which are developing countries in Asia. It is estimated that in developed countries in Europe and America, the total prevalence of LV is about 14\%, which is very different. It is recommended that future studies consider comparing the LV prevalence between developing and developed countries.

Among all the included Chinese studies, this single analysis had the lowest LV prevalence. Their analysis of the results believes that it has something to do with the nurse's attitude. They thought report violent behavior will not change anything. It is similar to the attitude of subjects in an empirical analysis study on how to deal with workplace bullying.\textsuperscript{10} This attitude may make nurses choose to endure silently, leading to insufficient reporting, resulting in measured values lower than true values, which can explain the low response rate. The results also show that unhappiness among colleagues is an important factor in workplace LV. It is suggested that the occurrence of LV may be related to a stressful environment, such as the zero tolerance attitude of the Hong Kong health department towards nursing negligence and media public opinion. Nurses are afraid of being blamed for jeopardizing their careers, are unwilling to help colleagues, and lack team cohesion. The formal nurses or old nurses are easy to despise or attack other nurses. The tedious and high-pressure work
will make nurses prone to physical and mental exhaustion. If they are subjected to LV again, their physical and mental health and work (Efficiency and performance) will be affected.\textsuperscript{18, 19, 26, 27} And further affect the nursing team atmosphere and quality have a negative impact, so nurses under this pressure may cause the occurrence of LV.

When looking for sources of heterogeneity, subgroup analysis suggested that each subgroup variable we set was not a source of heterogeneity; and meta-regression showed that sample size might be a source of heterogeneity. Sensitivity analysis of 14 articles showed that one study would affect the overall research results. Sensitivity analysis was conducted again after removing this paper, and the results showed the stability. There was publication bias in this meta-analysis, which may exaggerate the results of this study. Therefore, it is necessary to be more rigorous in the generalization of the conclusion.

The study showed the high level of LV, which should be paid attention to by nursing managers. Through the analysis, it is concluded that culture may cause the difference in nurses' perception of LV. In the future, researchers can focus on cultural differences to further explore and find effective intervention measures, so as to improve the adverse effects of LV on nurses' physical and mental health and patient safety. This study has the following limitations. Firstly, more than half of the studies included were in countries in the Asian region, and many countries lacked studies on prevalence of LV, so this result may not be completely representative of the global level. Taking into account the inconsistent cultural background due to the medical environment in different regions, we recommended that more studies about LV in nurse workplace be carried out in different regions to understand the overall situation. Secondly, while we have excluded studies that did not define and measure descriptions, and where the description of the perpetrator was unclear, inconsistencies are still inevitable. That is, the measurement of LV in this systematic review and meta-analysis were all self-report, self-designed and self-administered questionnaires, which may lead to subjective and inconsistent data reports, as no standard assessment tool existed. Therefore, it is suggested that a standard, comprehensive and objective evaluation tool should be developed to measure LV in the future. Finally, no grey literature was searched. We focused on LV prevalence worldwide. Considering the difficulty of searching grey literature in various regions and the fact that some grey literature may have been converted to published studies over time, it increases the
complexity of subsequent screening data. However, LV problem is sensitive, and the data of grey literature may explain some problems. Therefore, it is suggested that scholars pay attention to the screening of grey literature in the future.

5. Conclusion

The prevalence of LV in nurse workplace is high, with the rate of 33.08%. In addition, the analysis of this study showed, there are differences in LV prevalence among different regions, possibly influenced by cultural environment. But lack of sufficient evidence to support. It is suggested to further explore LV in terms of cultural differences in the future.

Patient and public involvement

No patient involved.

Contributorship statement

YZ and JC searched and checked the databases according to the inclusion and exclusion criteria, extracted the data and assessed their quality. YZ analyzed the data and wrote the draft of the paper. SQ, RY, JC, HW and XS gave advice on meta-analysis methodology and revised the paper. All authors contributed to reviewing or revising the paper. LM is the guarantors of this work and had full access to all the data in the study and take responsibility for its integrity and the accuracy of the data analysis. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no conflict of interest.

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Data sharing statement

No additional data available.

Ethics statements

Patient consent for publication: Not applicable.

Ethics approval: This study does not involve human participants.
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Legends

Figure 1 Screening flow chart
Figure 2 Forest plot of eligible studies
Figure 3 Sensitivity analysis estimating heterogeneity
Figure 4 Sensitivity analysis estimating heterogeneity
Figure 5 Funnel plots estimating small sample bias
Figure 6 Egger’s test estimating publication bias
Supplementary file 1 Search strategy
Figure 1. Screening flow chart

Records identified through database searching:
- PubMed (404), Cochrane (24), CINAHL (15), Embase (312), Wanfang (55), CNKI (47) (n=937)

Additional records identified through other sources (n=0)

Records after duplicates removed (n=510)

Records screened (n=114)

Records excluded (n=396)

Full-text articles assessed for eligibility (n=14)

Studies included in qualitative synthesis (n=14)

Studies included in quantitative synthesis (meta-analysis) (n=13)

Full-text articles excluded with reasons (n=100)
1. the abuser is not identified or the specific date of the abuser is not provided (n=23)
2. studies with unclear descriptions of nurse populations and events (n=76)
3. duplicate articles and/or data (n=1)
Figure 2 Forest plot of eligible studies

273x199mm (300 x 300 DPI)

NOTE: Weights are from random-effects model
Figure 3 Sensitivity analysis estimating heterogeneity

301x201mm (300 x 300 DPI)
Figure 4 Sensitivity analysis estimating heterogeneity

301x201mm (300 x 300 DPI)
Figure 5 Funnel plots estimating small sample bias

209x152mm (300 x 300 DPI)
Figure 6 Egger’s test estimating publication bias

209x152mm (300 x 300 DPI)
**Supplementary file 1:** Search strategy

PubMed/Cochrane/CNKI/Wanfang:
(lateral violence OR horizontal violence OR horizontal hostility OR bullying OR workplace incivility) And nurse.

CINAHL:
(lateral violence OR horizontal violence OR horizontal hostility OR bullying OR workplace incivility) And nurse And English language.

Embase:
(lateral violence OR horizontal violence OR horizontal hostility OR bullying OR workplace incivility) And nurse And humans And English language.
**Meta-analysis of observational studies in epidemiology: a proposal for reporting.**

Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group

| Reporting guideline provided for? | Meta-analysis and Systematic review of observational studies in epidemiology |
|----------------------------------|--------------------------------------------------------------------------------|
| (i.e.exactly what the authors state in the paper) |                                                                                |
| **Full bibliographic reference** | **Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, Moher D, Becker BJ, Sipe TA, Thacker SB. Meta-analysis of observational studies in epidemiology: a proposal for reporting. Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group. JAMA. 2000; 283(15):2008-2012.** |
| **Language** | **English** |
| **PubMed ID** | **10789670** |
| **Reporting guideline acronym** | **MOOSE** |
| **Study design** | **Meta analyses/Systematic reviews** |
| **Clinical area** | **Public health** |
| **Applies to the whole report or to individual sections of the report?** | **Whole report** |
| **Record last updated on** | **December 4, 2021** |
| Section and Topic | Item # | Checklist item                                                                 | Location where item is reported |
|------------------|--------|---------------------------------------------------------------------------------|---------------------------------|
| TITLE            | 1      | Identify the report as a systematic review.                                    | 1                               |
| ABSTRACT         | 2      | See the PRISMA 2020 for Abstracts checklist.                                   | 1-2                             |
| INTRODUCTION     | 3      | Describe the rationale for the review in the context of existing knowledge.    | 2-3                             |
| Objectives       | 4      | Provide an explicit statement of the objective(s) or question(s) the review addresses. | 3                               |
| METHODS          | 5      | Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses. | 4                               |
| Eligibility criteria | 6  | Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted. | 4                               |
| Information sources | 7   | Present the full search strategies for all databases, registers and websites, including any filters and limits used. | 4                               |
| Search strategy  | 8      | Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process. | 4                               |
| Selection process| 9      | Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process. | 4                               |
| Data collection process | 10 | List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect. | 4                               |
| Data items       | 10b    | List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information. | 4                               |
| Study risk of bias assessment | 11 | Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process. | 5                               |
| Effect measures  | 12     | Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results. | 5                               |
| Synthesis methods| 13a    | Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)). | 5                               |
|                  | 13b    | Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions. | 5                               |
|                  | 13c    | Describe any methods used to tabulate or visually display results of individual studies and syntheses. | 5                               |
|                  | 13d    | Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used. | 5                               |
|                  | 13e    | Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression). | 5                               |
|                  | 13f    | Describe any sensitivity analyses conducted to assess robustness of the synthesized results. | 5                               |
| Reporting bias assessment | 14 | Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases). | 5                               |
| Certainty assessment | 15 | Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome. | 5                               |
| Section and Topic | Item # | Checklist item                                                                                                                                                                                                                                                                                                                                 | Location where item is reported |
|-------------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| RESULTS           |        |                                                                                                                                                                                                                                                                                                                                                                                                         |
| Study selection   | 16a    | Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.                                                                                                                                         | 5                              |
|                   | 16b    | Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.                                                                                                                                                                                                                   | 5                              |
| Study characteristics | 17    | Cite each included study and present its characteristics.                                                                                                                                                                                                                                                                                   | 8                              |
| Risk of bias in studies | 18 | Present assessments of risk of bias for each included study.                                                                                                                                                                                                                                                                                  | 9-10                           |
| Results of individual studies | 19 | For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.                                                                                     | 6-7                            |
| Results of syntheses | 20a | For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.                                                                                                                                                                                                                                    | 8-9                            |
|                   | 20b | Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect. | 8-9                            |
|                   | 20c | Present results of all investigations of possible causes of heterogeneity among study results.                                                                                                                                                                                                                                            | 9-10                           |
|                   | 20d | Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.                                                                                                                                                                                                                                   | 10                             |
| Reporting biases  | 21    | Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.                                                                                                                                                                                                                     | 10                             |
| Certainty of evidence | 22 | Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.                                                                                                                                                                                                                                            | 8-9                            |
| DISCUSSION        |        |                                                                                                                                                                                                                                                                                                                                                                                                         |
| Discussion        | 23a    | Provide a general interpretation of the results in the context of other evidence.                                                                                                                                                                                                                                                           | 10-12                          |
|                   | 23b    | Discuss any limitations of the evidence included in the review.                                                                                                                                                                                                                                                                            | 12-13                          |
|                   | 23c    | Discuss any limitations of the review processes used.                                                                                                                                                                                                                                                                                      | 12-13                          |
|                   | 23d    | Discuss implications of the results for practice, policy, and future research.                                                                                                                                                                                                                                                             | 12                             |
| OTHER INFORMATION |        |                                                                                                                                                                                                                                                                                                                                                                                                         |
| Registration and protocol | 24a | Provide registration information for the review, including register name and registration number, or state that the review was not registered.                                                                                                                                                                                                   | NA                             |
|                   | 24b    | Indicate where the review protocol can be accessed, or state that a protocol was not prepared.                                                                                                                                                                                                                                           | NA                             |
|                   | 24c    | Describe and explain any amendments to information provided at registration or in the protocol.                                                                                                                                                                                                                                          | NA                             |
| Support           | 25    | Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.                                                                                                                                                     | 13                             |
| Competing interests | 26    | Declare any competing interests of review authors.                                                                                                                                                                                                                                                                                         | 13                             |
| Availability of data, code and other materials | 27 | Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.                                                                                   | 13                             |