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The effect of interventions aimed at improving nurses' work engagement in the workplace: a systematic review and meta-analysis protocol

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Title: The effect of interventions aimed at improving nurses' work engagement in the workplace: a systematic review and meta-analysis protocol

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ABSTRACT

Introduction

Work engagement is associated with various positive outcomes in the nursing workplace. Hence, it is important to improve nurses' work engagement to ensure their mental and physical health, organizational health in the nursing workplace, and quality of care they provide. No systematic review or meta-analysis has been conducted to evaluate the effect of intervention studies using randomized controlled trials (RCTs) aimed at improving nurses' work engagement. Therefore, to examine the effectiveness that is reported in published RCT studies, we apply a protocol for a systematic review and meta-analysis.

Methods and analysis

Published studies are searched using the following electronic databases: Cochrane Central Register of Controlled Trials, PubMed (MEDLINE), CINAHL, PsycINFO, PsycARTICLES, Web of Science, and Japan Medical Abstracts Society. Studies that aim to evaluate the effect of interventions on improving nurses' work engagement, use a randomized controlled trial design, provide sufficient data (sample sizes, means, and standard deviations) to calculate effect sizes with 95% confidence intervals, and are published as original articles written in English or Japanese are included. The study selection and risk of bias assessment is performed independently by two reviewers. A meta-analysis is performed to statistically synthesize the included studies. Publication bias is assessed via meta-analysis using Egger's test and a visual funnel plot. Heterogeneity is evaluated using the Q statistic.

Ethics and dissemination

Given that this systematic review and meta-analysis is based on existing studies, it is exempt from ethical approval. The outcomes and findings of this research will be disseminated through publications in peer-reviewed international journals and presentations at conferences, symposiums, and seminars related to the field.

Strengths and limitations of this study

► This systematic review and meta-analysis will offer the strongest evidence about the effectiveness of interventions aimed at improving nurses' work engagement in the workplace.

► The findings from the study will be useful for implementing interventions to improve work engagement among nurses in the workplace.

► This study is limited because the findings cannot be generalized to the demographic characteristics of the participants that are not included in the selected studies.

► The present search strategy is limited to only two languages, which may result in the exclusion of relevant data that has been published in other languages.

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PROSPERO registration is being applied for.

INTRODUCTION

Work engagement is a concept based on a positive psychology perspective in the occupational mental health.[1, 2] It is defined as a positive and fulfilling mental state toward work.[3, 4] Work engagement consists of three factors, namely, "feeling proud of and fulfilled by work" (Dedication), "being enthusiastic about work" (Absorption), and "feeling energized and energetic from work" (Vigor), and it is positioned as the opposite of burnout.[3] Workers with high work engagement have sufficient energy to meet and perform the demands of their jobs well.[5] In the nursing workplace, work engagement is positively associated with nurses' physical and mental health,[6, 7] improved well-being and job performance,[8] increased job satisfaction,[9] decreased turnover intentions,[10-12] and improved quality of care provided to patients.[13-15] Thus, work engagement is associated with various positive outcomes in the nursing workplace. However, nurses have been reported to experience high occupational stress,[16] which can cause burnout.[17] Work engagement has been reported to be effective in reducing occupational stress among nurses.[14, 18] Therefore, it is important to improve nurses' work engagement to ensure their mental and physical health, organizational health in the nursing workplace, and quality of care.

Regarding intervention programs to improve work engagement, systematic reviews and meta-analyses of findings in the general workforce have indicated that several individual- and group-based intervention programs have been developed, including building work resources (e.g., support from supervisors and co-workers, increased job discretion, increased feedback from supervisors), building personal resources (e.g., resiliency training), leadership training (e.g., improvement of management skills for managers), and health promotion (e.g., stress management).[19, 20] A systematic review of nurses also reported that work and personal resources are antecedents influencing nurses' work engagement.[8] A meta-analysis based on 14 controlled studies in the general workforce reported a significant small overall effect size (Hedges g = 0.29, 95% CI = 0.12 to 0.46).[21] However, only one study conducted among nurses was included in the meta-analysis. The results of systematic reviews and meta-analyses of interventions aimed at improving work engagement in the general workforce may not be applicable to nurses. Nurses operate in occupation-specific work cultures and environments compared to the general workforce. The effect of interventions may be difference. A systematic review and meta-analysis of intervention studies specific to nurses is needed. However, there have been no systematic reviews or meta-analyses of intervention studies using randomized controlled trials (RCTs) aimed at improving nurses' work engagement. Improving nurses' work engagement is an urgent issue in the nursing workplace, and a systematic review and meta-analysis of interventions is needed for a comprehensive understanding and evidence-based implementation of these interventions.

This systematic review and meta-analysis aim to understand and evaluate the overall programs and effectiveness of interventions aimed at improving nurses' work engagement in the workplace. This

research reviews studies that use RCTs to examine the effectiveness of interventions.

METHODS AND ANALYSIS

Study design

This study protocol for a systematic review and meta-analysis of intervention trials (RCTs) adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA-P) guidelines[22] (see Online Supplementary File 1). The results are presented in accordance with the PRISMA statement.[23] The study protocol was officially registered with the UMIN (registration number: UMIN000053201) and is applying for registration with the PROSPERO.

Eligibility criteria

The participants, interventions, comparisons, and outcomes (PICO) of the studies included in this systematic review and meta-analysis is defined as follows: (P) all nurses, (I) any type or mode of intervention, (C) no intervention or not an intervention that aims to improve work engagement, and (O) work engagement. We include intervention studies (RCTs) conducted on a population of nurses regardless of their rank or years of nursing service. We also incorporate studies that focus solely on nurses screened for low work engagement, if any, and conduct subgroup analyses of these studies alone. We exclude studies that involve practical nurses or nursing aides and those that include other healthcare workers, such as doctors. There are no exclusion criteria regarding the participants' employment status or healthcare settings in which they are employed.

In this study, interventions are broadly defined as attempts to enhance nurses' work engagement. Any type or mode of intervention is included in this study. The comparisons are defined as a no-intervention group, waitlist control, treatment as usual (such as education or training provided by the nursing association, but not interventions specifically targeting work engagement), or alternative interventions (not aimed at improving work engagement).

Aspects of the outcome (i.e., work engagement) are assessed using a self-reported measure such as the Utrecht Work Engagement Scale (UWES).[24, 25] This systematic review and meta-analysis includes studies that calculate the total scores for work engagement. Work engagement is an opposing concept to burnout, but work engagement scores cannot be estimated from burnout scores which are measured using, for example, the Maslach Burnout Inventory-General Survey (MBI-GS).[26] Therefore, studies using the MBI-GS are excluded. In addition, studies that do not conduct statistical analyses to examine the intervention effects are excluded.

This systematic review and meta-analysis include studies that aim to evaluate the effect of interventions on improving nurses' work engagement, use an RCT design, provide sufficient data (sample sizes, means, and standard deviations [SDs]) to calculate the effect sizes with 95% confidence intervals (CIs), and are published as original articles written in English or Japanese.

Information sources, search strategy, and data management

Systematic searches of published studies are performed using multiple electronic databases, including the Cochrane Central Register of Controlled Trials (CENTRAL), PubMed (MEDLINE), CINAHL, PsycINFO, PsycARTICLES, Web of Science, and the Japan Medical Abstracts Society. The search terms encompass those pertinent to the research PICO. The search focuses on terms that are relevant to the research PICO. The specific search terms and strategies are outlined in Supplementary File 2, which is available online. All the identified studies are managed using Microsoft Excel (Microsoft Corp., Redmond, WA, USA). Prior to the study selection process, duplicate citations in the Excel files, are removed by KK, the first author. All decisions regarding the study are documented.

Study selection process

The study selection process comprises two stages. In the first stage, KK and AI independently conduct a screening of the studies based on the inclusion criteria. They review the titles and abstracts of the studies and assess their eligibility based on the previously established criteria. In the second stage, the full texts of eligible studies are obtained and reviewed using a standard form to determine their eligibility for inclusion in this review. Any discrepancies in the assessment are recorded, and if they cannot be resolved, they are addressed through discussion among all the authors. The reference lists of the studies are carefully examined for any additional eligible studies, and the corresponding authors of the eligible studies are contacted if the results of the publication are unclear, may have multiple interpretations, or if the reported results do not include data relevant to our analysis. A flowchart illustrating the review process is presented.

Data extraction

Two review authors, KK and AI, independently extract data from the included studies using a standardized data extraction form (see Online Supplementary File 3). Any disagreements or inconsistencies are recorded and resolved through discussion among all authors until a consensus is reached. The extracted data include the following: Source (i.e., database, journal, and year of publication), country where the study is conducted, number of participants included in the analysis, sampling framework, participants' demographic characteristics (i.e., mean age, sex proportions, years of nursing experience, and employment status), number of participants who are excluded or lost to follow-up, contents of the intervention program, control condition (i.e., no intervention, waiting-list control, or other), Outcome variables, length of follow-up, and sufficient data (i.e., the number of participants in each group (N), mean differences (MD) between groups, and SD for the outcome) to calculate the effect size with 95% CIs to determine the effect of interventions on the work engagement of nurses. This extraction format is experimental and can be modified as required. Relevant research

teams of the studies are contacted regarding the availability of unpublished or missing data.

Risk-of-bias assessment

Two review authors, KK and AI, independently assess the methodological quality of the included studies using the Grading of Recommendation Assessment, Development, and Evaluation (GRADE) approach, which is Cochrane Collaboration's risk-of-bias tool 2.[27] This tool evaluates the possible sources of bias in intervention studies based on five categories: (1) bias arising from the randomization process, (2) bias due to deviations from intended interventions, (3) bias due to missing outcome data, (4) bias in measurement of the outcome, (5) bias in selection of the reported result. Each category will be evaluated based on its risk of bias, with a determination of low risk, some concerns, or high risk of bias. In addition, the tool evaluates the overall risk of bias utilizing the GRADE approach to grade the confidence in the evidence. Any inconsistencies in the quality assessment are discussed and resolved by all the authors hereof. To assess meta-bias, publication bias is evaluated using funnel plots, for asymmetry, and Egger's test.

Data synthesis and statistical methods

The included studies are statistically synthesized using meta-analysis to estimate the pooled effect (SMD) of interventions aimed at improving nurses' work engagement. We plan to combine these studies with similar follow-up periods. We consider the effects over the following follow-up periods: (i) Up to one month, (ii) From one month to six months, and (iii) Over six months. We produce forest plots of the between-group and post-intervention effect sizes for work engagement, along with 95% CIs. The number of participants and their scores, such as the means and standard deviations *(SDs)* for the intervention and control groups for work engagement, are entered into the Review Manager software.[28] The magnitude of the effect size is interpreted as small (0.2), medium (0.5), or large (0.8), according to established criteria.[29]

A meta-analysis is performed when at least three eligible studies are identified. If it is inappropriate to perform a meta-analysis (i.e., fewer than three studies are eligible and included), the results are presented in a narrative form. Publication bias was examined using funnel plots and Egger's test. Statistical heterogeneity was assessed using the chi-square (χ^2) test with Cochran's Q statistic and I^2 value.[30] I^2 values of 25%, 50%, and 75% indicate low, medium, and high heterogeneity, respectively.[31] An I^2 value of $\geq$ 50% is considered to indicate considerable heterogeneity. If there is little or no statistical heterogeneity (i.e., an I^2 value of less than 50%) in a comparison, we pool the results using a fixed effects model. If the I^2 statistic is greater than 50%, we use a random effects model.[32]

As the effect of work engagement interventions may differ according to their typology, subgroup analyses are conducted to compare the results. The major possible grouping characteristics include the

following four categories of work engagement interventions: i) job resource building, ii) personal resource building, iii) leadership training, and iv) health promotion.[19, 20] Each category is treated as another stratification factor, and any subgroup differences are reported and explained. Moreover, we conduct subgroup analyses of studies that exclusively focus on nurses who have been screened for low work engagement. To assess the effect of the risk of bias on the pooled results, a sensitivity analysis is also conducted for the included studies classified as low risk according to the Cochrane Collaboration's risk-of-bias tool.[33] All extracted data and analyzed results are deposited by the corresponding author, and they are available for external reviewers upon request.

Patient and public involvement statement

This study does not involve any human subjects or participants, as the study protocol is for a systematic review and meta-analysis.

Ethics and dissemination

Given that this systematic review and meta-analysis is based on existing studies, it is exempt from ethical approval. The outcomes and findings of this research will be disseminated through publications in peer-reviewed international journals and presentations at conferences, symposiums, and seminars related to the field.

STRENGTHS AND LIMITATIONS

The greatest strength of this study is that, to the best of our knowledge, it will be the first systematic review and meta-analysis to provide evidence of the effects of interventions aimed at improving nurses' work engagement in the workplace. If an effect of interventions on improving work engagement of nurses is confirmed by this meta-analysis, the finding will be helpful in disseminating and implementing interventions to improve work engagement among nurses in the workplace. Since work engagement of nurses is positively associated with individual, organizational, and patient care outcomes,[8, 9, 15] it will further contribute to health and well-being of nurses, better organizational performance of a health care institute, and maybe to a better health care to patients.

However, this study has some limitations. First, the generalizability of our findings may be limited due to the demographic characteristics of the participants included in the selected studies. Second, there is a constraint that the article search is only conducted in two languages, which may exclude relevant data published in other languages. Third, the accuracy of systematic reviews and meta-analyses is affected by publication bias. Even studies that were not significant but of high quality tended not to be made public. To mitigate the impact of this bias, it is essential to contact the relevant research teams and inquire about the availability of unpublished or missing data.

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Author Contributions

The study was conceived and designed by KK, and KI and NK supervised this study. The initial draft of the manuscript was written by KK, and all authors revised it critically for important intellectual content and contributed to the final manuscript. All authors read and approved the final manuscript. The entire study process (i.e., the data collection, assessment, and synthesis) will be conducted by all of the authors.

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Competing interests statement

The authors declare no conflict of interest.

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Supplementary File 2.

Search terms for PubMed

(nurses[Mesh] OR “health personnel”[Mesh] OR "nurse*"[tiab] OR "nursing"[tiab] OR nursery[tiab] OR “health care personnel*”[tiab] OR “healthcare personnel*”[tiab] OR “health care worker*”[tiab] OR “healthcare worker*”[tiab] OR “health worker*”[tiab] OR “health professional*”[tiab] OR “health care professional*”[tiab] OR “healthcare professional*”[tiab] OR “medical care personnel*”[tiab] OR “health staff*”[tiab] OR “healthcare staff*”[tiab] OR “health care staff*”[tiab] OR “health care provider*”[tiab] OR “healthcare provider*”[tiab] OR "workforce"[tiab] OR "workplace*"[tiab] OR "work place*"[tiab] OR "worksite*"[tiab] OR "work site*"[tiab])

AND

(“work engagement”[Mesh] OR "work engag*"[tiab] OR engag*[tiab])

AND

(randomized controlled trial [pt] OR (randomized[tiab] AND controlled[tiab] AND trial[tiab]))

Supplementary File 4. Standardized data extraction form

ID	No	Title	Author	Source (Database, Journal, Year)	Country where the study was conducted	Number of participants included in the analysis	Sampling framework	Participants' demographic characteristics (imean age, sex proportions, years of nursing experience, and employment status)	Number of participants who were excluded or lost to follow-up	Contents of the intervention program	Control condition (no intervention, waiting-list control, or other)	Outcome variable	Length of follow-up	Sufficient data (the number of participants in each group (N), mean differences (MD) between groups, and SD for the outcome (work engagement))

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Title: Effects of Interventions Aimed at Improving Nurses' Work Engagement in The Workplace: A Systematic Review and Meta-Analysis Protocol

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ABSTRACT

Introduction

Work engagement enhances nurses' physical and mental health, well-being, job performance, and satisfaction. This reduces turnover rates and improves patient care quality, making work engagement a crucial factor in the nursing workplace. However, no systematic review or meta-analysis has yet explored the effects of randomized controlled trial (RCT) interventions specifically aimed at improving nurses' work engagement. The aim of this study is to evaluate the effectiveness of these interventions, providing healthcare organizations with evidence-based recommendations for enhancing work engagement among nurses.

Methods and Analysis

This systematic review and meta-analysis will use PICO criteria: (P) nurses, (I) psychosocial interventions, (C) no intervention or non-work engagement interventions, and (O) work engagement as a primary outcome. Published studies will be searched by September 2025 using databases such as the Cochrane Central Register of Controlled Trials, PubMed (MEDLINE), EMBASE, CINAHL, PsycINFO, PsycARTICLES, and the Japan Medical Abstracts Society. Eligible studies must use RCT designs, assess the impact of interventions on nurses' work engagement, and provide adequate data (sample sizes, means, and standard deviations) to calculate effect sizes with 95% confidence intervals. Publications must be written in English or Japanese as original articles. Two reviewers will independently select studies and assess the risk of bias. The methodological quality of the included studies will be evaluated using the Grading of Recommendation Assessment, Development, and Evaluation approach. A meta-analysis will be conducted for statistical synthesis and publication bias will be assessed using Egger's test and a visual funnel plot. Heterogeneity will be evaluated using Q statistics.

Ethics and Dissemination

This systematic review and meta-analysis are based on existing studies and do not require ethical approval. The findings will be shared through publications in peer-reviewed international journals and presentations at relevant conferences, symposia, and seminars.

PROSPERO registration number: CRD42024510479).

Strengths and Limitations of this Study

► The primary strength of this study is its exclusive inclusion of articles using an RCT design and uses systematic literature review with a comprehensive database search.

► The limitation of this study is that the findings may not be generalized to demographic

characteristics of the participants that are not included in the selected studies.

► The search strategy is restricted to publications in only two languages, which may result in the exclusion of relevant data published in other languages.

INTRODUCTION

Work engagement is predicated on a positive psychological perspective on occupational mental health[1, 2]. It is defined as a positive and fulfilling mental state toward work[3, 4]. Work engagement encompasses three factors: "feeling proud of and fulfilled by work" (Dedication), "being enthusiastic about work" (Absorption), and "feeling energized and energetic from work" (Vigor); furthermore, it is positioned as the opposite of burnout[3]. Employees with high work engagement possess sufficient energy to meet job requirements[5]. Work engagement among nurses positively correlates with nurses' physical and mental health[6, 7], improved well-being and job performance[8], increased job satisfaction[9], decreased turnover intentions[10-12], and improved quality of care provided to patients[13-15]. Consequently, work engagement is associated with numerous positive outcomes in the nursing workplace. However, nurses frequently experience high levels of occupational stress[16], which can cause burnout[17]. Research indicates that work engagement can effectively attenuate nurses' occupational stress[14, 18]. Therefore, it is important to improve nurses' work engagement to ensure their mental and physical health, organizational health in the nursing workplace, and the quality of care.

Regarding intervention programs to improve work engagement, systematic reviews of findings in the general workforce have indicated that several psychosocial intervention programs have been developed and can be effective, including building work resources (e.g., support from supervisors and co-workers, increased job discretion, and increased feedback from supervisors), building personal resources (e.g., resiliency training), leadership training (e.g., improvement of management skills for managers), and health promotion (e.g., stress management skills such as cognitive behavioral therapy)[19, 20]. A meta-analysis based on 14 controlled studies in the general workforce reported that the aforementioned psychosocial interventions revealed a significantly small overall effect size for improving work engagement (Hedges g = 0.29, 95% confidence intervals (CI) = 0.12 to 0.46)[21]. However, this meta-analysis included non-randomized controlled trials. The design of randomized controlled trials (RCTs) minimizes bias and confounding factors that are more likely to affect non-randomized controlled studies. In the context of work engagement interventions, RCTs ensure that the effects of interventions can be attributed to the intervention itself rather than to external factors[8]. Therefore, the results of this meta-analysis should be interpreted with caution. Additionally, only one study conducted among nurses was included in this meta-analysis. The results of systematic reviews and meta-analyses of interventions aimed at improving work engagement in the general workforce may not be applicable to nurses. Nurses operate in occupation-specific

work cultures and environments compared to the general workforce. The effects of these interventions may differ. Therefore, a systematic review and meta-analysis of nurse-specific intervention studies is required. However, to the best of our knowledge, there have been no systematic reviews or meta-analyses of intervention studies using RCTs to improve nurses' work engagement. A previous systematic review in nursing reported the factors influencing work engagement among nurses; however, it did not comprehensively assess the intervention effects[8]. Another systematic review indicated updating antecedents for improving nurses' work engagement; however, it did not focus on the impact of psychosocial interventions targeting nurses[22]. There is limited evidence on the effectiveness of interventions in improving nurses' work engagement. Improving nurses' work engagement is a pressing issue in the nursing workplace, and a systematic review and meta-analysis of interventions is required for a comprehensive understanding and evidence-based implementation of these interventions.

Therefore, the aim of this study is to evaluate the effectiveness of interventions aimed at improving nurses' work engagement in the workplace. This study reviews studies that used RCTs to examine the effectiveness of interventions. This review will provide healthcare organizations with evidence-based recommendations to enhance work engagement among nurses, ultimately leading to better well-being, reduced burnout, and improved quality of patient care. These findings will also help guide the development of future interventions and policies in healthcare settings.

METHODS AND ANALYSIS

Study Design

This systematic review and meta-analysis of intervention trials (RCTs) will adhere to the methodological framework of the Cochrane Handbook for Systematic Reviews of Interventions[23]. This study protocol has been reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA-P) guidelines[24] (see Online Supplementary File 1). The results are presented in accordance with the PRISMA statement[25]. The study protocol was officially registered with PROSPERO (registration number: CRD42024510479). The study is planned to begin in August 2025 and will be completed by July 2028. This timeline includes the literature search, data extraction, analysis, and reporting phases.

Eligibility Criteria

The participants, interventions, comparisons, and outcomes (PICO) of the studies included in this systematic review and meta-analysis were defined as follows: (P) all

nurses, (I) psychosocial interventions, (C) no intervention or not an intervention aimed at improving work engagement, and (O) work engagement as a primary outcome. We included intervention studies (RCTs) conducted on a population of nurses regardless of their rank or years of nursing service. We also incorporated studies that focused solely on nurses screened for low work engagement, if any, and conducted subgroup analyses of these studies alone. We excluded studies that involved practical nurses or nursing aides and those that included other healthcare workers, such as doctors. There are no exclusion criteria regarding the participants' employment status or the healthcare settings in which they are employed.

This study will include psychosocial interventions to enhance nurses' work engagement. Psychosocial interventions are defined as interventions that focus on psychological and social factors, such as support from supervisors and co-workers, attempts to increase job discretion, feedback from supervisors, resiliency training, leadership training, and stress management skills to improve individuals' thoughts, behaviors, and workplace social relationships[26].

Comparisons are defined as a no-intervention group, waitlist control, treatment as usual (such as education or training provided by the nursing association, but not interventions specifically targeting work engagement), or alternative interventions (not aimed at improving work engagement).

The aspects of the outcome (i.e., work engagement) are assessed using self-reported measures such as the Utrecht Work Engagement Scale (UWES)[27, 28]. This systematic review and meta-analysis includes studies that calculate total scores for work engagement. Work engagement is a concept opposing burnout, however, work engagement scores cannot be estimated from burnout scores measured using, for example, the Maslach Burnout Inventory-General Survey (MBI-GS)[29]. Therefore, studies that used the MBI-GS will be excluded. In addition, we plan to include only studies that measure work engagement as the primary outcome. This approach ensures that our analysis focuses on evaluating the direct effects of interventions specifically aimed at improving work engagement among nurses. Studies in which work engagement is measured as a secondary outcome, along with other objectives, will be excluded. Moreover, studies that do not conduct statistical analyses to examine the effects of the intervention are excluded.

This review focuses exclusively on RCTs owing to their ability to provide the highest level of evidence for evaluating the efficacy of interventions. By limiting the inclusion to RCTs, we intend to ensure a high level of evidence and consistency across the studies, allowing for more reliable conclusions regarding the effectiveness of interventions aimed at improving work engagement among nurses. Although non-randomized studies can

provide useful insights, they will be excluded from this review to maintain the rigor of the analysis. Systematic reviews and meta-analyses focusing on RCTs provide the highest level of evidence that is critical for informing practice and policy decisions[30].

In this study, the search is limited to English and Japanese literature. This is because English is widely used as an international academic language, and several studies have been published in English. In addition, all members of this research team are Japanese and can accurately evaluate and interpret the Japanese literature. This minimizes the influence of translation errors and ensures consistency in data interpretation.

This systematic review and meta-analysis include studies that aim to evaluate the effect of interventions on improving nurses' work engagement; use an RCT design; provide sufficient data (sample sizes, means, and standard deviations [SDs]) to calculate the effect sizes with 95% Cis; and are published as original articles written in English or Japanese.

Information Sources, Search Strategy, and Data Management

Systematic searches of published studies will be performed by September 2025 using multiple electronic databases, including the Cochrane Central Register of Controlled Trials (CENTRAL), PubMed (MEDLINE), EMBASE, CINAHL, PsycINFO, PsycARTICLES, and the Japan Medical Abstracts Society. The search terms encompass those relevant to the research PICO. Specific search terms and strategies are outlined in Supplementary File 2 and are available online. All identified studies are managed using Microsoft Excel (Microsoft Corp., Redmond, WA, USA). Prior to the study selection process, duplicate citations in Excel files will be removed by KK, the first author. All decisions regarding this study will be documented.

Study Selection Process

The study selection process has two stages. In the first stage, KK and AI will independently screen for studies based on the inclusion criteria. They will review the titles and abstracts of the studies and assess their eligibility based on previously established criteria. In the second stage, the full texts of eligible studies will be obtained and reviewed using a standard form to determine their eligibility for inclusion. Any discrepancies in the assessment will be recorded, and if they cannot be resolved, they will be addressed through discussions among all authors. The reference lists of the studies will be carefully examined for any additional eligible studies, and the corresponding authors of the eligible studies will be contacted if the results of the publication are unclear, may have multiple interpretations, or if the reported results do not include data relevant to our analysis. A flowchart illustrating the review process will be presented.

Data Extraction

Two review authors, KK and AI, will independently extract data from the included studies using a standardized data extraction form. Any disagreements or inconsistencies will be recorded and resolved through discussion among all authors until a consensus is reached. The extracted data will include the following: source (i.e., database, journal, and year of publication), country where the study is conducted, number of participants included in the analysis, sampling framework, participants' demographic characteristics (i.e., mean age, sex proportions, years of nursing experience, and employment status), number of participants who are excluded or lost to follow-up, contents of the intervention program, control condition (i.e., no intervention, waiting-list control, or other), outcome variables, length of follow-up, and sufficient data (i.e., the number of participants in each group (N), mean differences (MD) between groups, and SD for the outcome) to calculate the effect size with 95% CIs to determine the effect of interventions on the work engagement of nurses. This extraction format is experimental and can be modified as required. Relevant research teams will be contacted regarding the availability of unpublished and missing data.

Risk-of-Bias Assessment

Two review authors, KK and AI, will independently assess the methodological quality of the included studies using the Grading of Recommendation Assessment, Development, and Evaluation (GRADE) approach, which is the Cochrane Collaboration's risk-of-bias tool 2[31]. This tool evaluates possible sources of bias in intervention studies based on the following five categories: (1) bias arising from the randomization process, (2) bias owing to deviations from intended interventions, (3) bias owing to missing outcome data, (4) bias in outcome measurement, and (5) bias in the selection of reported results. Each category will be evaluated based on its risk of bias, with a determination of low risk, some concern, or high risk of bias. In addition, the tool evaluates the overall risk of bias by utilizing the GRADE approach to grade confidence in the evidence. All authors will discuss and resolve any inconsistencies in the quality assessment. Publication bias will be evaluated using funnel plots to assess meta-bias for asymmetry, as well as Egger's test.

Data Synthesis and Statistical Methods

The included studies are statistically synthesized using meta-analysis to estimate the pooled effect (SMD) of interventions aimed at improving nurses' work engagement. Therefore, we plan to combine these studies with similar follow-up periods. We will

consider the effects over the following follow-up periods: (i) up to 1 month, (ii) from 1 to 6 months, and (iii) over 6 months. We will produce forest plots of the between-group and post-intervention effect sizes for work engagement, along with 95% CIs. The number of participants and their scores, such as the means and SDs for the intervention and control groups for work engagement, will be entered into the Review Manager[32]. The magnitude of the effect size is interpreted as small (0.2), medium (0.5), or large (0.8), according to established criteria[33].

A meta-analysis will be performed when at least three eligible studies are identified. If it is inappropriate to perform a meta-analysis (i.e., fewer than three studies are eligible and included), the results will be presented in a narrative form. Publication bias will be examined using funnel plots and Egger's test. Statistical heterogeneity will be assessed using the chi-square (χ^2) test with Cochran's Q statistic and I^2 value[34]. I^2 values of 25%, 50%, and 75% indicate low, medium, and high heterogeneity, respectively[35]. An I^2 value of $\geq$ 50% indicates considerable heterogeneity. If there is little or no statistical heterogeneity (i.e., an I^2 value of less than 50%) in a comparison, we will pool the results using a fixed-effects model. If the I^2 statistic is greater than 50%, a random-effects model is used[36].

As the effects of work engagement interventions may differ according to typology, subgroup analyses are conducted to compare the results. The major possible grouping characteristics include the following four categories of work engagement interventions: i) job resource building, ii) personal resource building, iii) leadership training, and iv) health promotion[19, 20]. Each category is treated as another stratification factor, and any subgroup differences will be reported and explained. Moreover, we will conduct subgroup analyses of studies that exclusively focus on nurses screened for low work engagement. To assess the effect of the risk of bias on the pooled results, a sensitivity analysis will also be conducted for the included studies classified as low-risk according to the Cochrane Collaboration's risk-of-bias tool[37]. All extracted data and analyzed results have been deposited by the corresponding author and are available to the external reviewers upon request.

Patient and Public Involvement Statement

None.

Ethics and Dissemination

Given that this systematic review and meta-analysis is based on existing studies, it is exempt from ethical approval. The outcomes and findings of this study will be

disseminated through publications in peer-reviewed international journals and presentations at conferences, symposia, and seminars related to the field.

STRENGTHS AND LIMITATIONS

The greatest strength of this study is that, to the best of our knowledge, it will be the first systematic review and meta-analysis to provide evidence of the effects of interventions aimed at improving nurses' work engagement in the workplace. If this meta-analysis confirms the positive impact of such interventions, the findings will support broader dissemination and implementation of strategies to improve work engagement among nurses. Because nurses' work engagement is positively associated with outcomes at individual, organizational, and patient care levels[8, 9, 15], these insights will further contribute to enhanced health and well-being of nurses, better organizational performance within healthcare institutes, and perhaps better health care outcomes for patients.

However, this study has certain limitations. First, the generalizability of our findings may be limited by the demographic characteristics of the participants included in the studies. Second, limiting the article search to only two languages may result in the exclusion of relevant data published in other languages. Third, the accuracy of the systematic reviews and meta-analyses could be affected by publication bias, as high-quality studies with non-significant findings may be less likely to be published. To mitigate this bias, it is essential to contact relevant research teams to inquire about the availability of unpublished or missing data.

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Author Contributions

The study was conceived and designed by KK, and KI and NK supervised this study. The initial draft of the manuscript was written by KK, and all authors including AI revised it critically for important intellectual content and contributed to the final manuscript. All authors read and approved the final manuscript. The entire study process (i.e., the data collection, assessment, and synthesis) will be conducted by all the authors. The guarantor of this study is KK.

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Competing Interests Statement

The authors declare no conflict of interest.

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Supplementary File 2.

Search terms for Cochrane Central Register of Controlled Trials (CENTRAL)

(nurse* OR "health personnel*" OR "nursing staff*" OR "registered nurse*" OR "health care personnel*" OR "healthcare personnel*" OR "health care worker*" OR "healthcare worker*" OR "health care professional*" OR "healthcare professional*" OR "health care staff*" OR "healthcare staff*" OR "health care provider*" OR "healthcare provider*")
AND
("work engagement" OR "work engag*" OR engag*)
AND
("randomized controlled trial" OR (randomized AND controlled AND trial))

Search terms for PubMed

(nurses[Mesh] OR “health personnel”[Mesh] OR nurse*[tiab] OR "nursing staff*"[tiab] OR "registered nurse*"[tiab] OR “health care personnel*”[tiab] OR “healthcare personnel*”[tiab] OR “health care worker*”[tiab] OR “healthcare worker*”[tiab] OR “health care professional*”[tiab] OR “healthcare professional*”[tiab] OR “health care staff*”[tiab] OR “healthcare staff*”[tiab] OR “health care provider*”[tiab] OR “healthcare provider*”[tiab])
AND
(“work engagement”[Mesh] OR "work engag*"[tiab] OR engag*[tiab])
AND
(“randomized controlled trial” [pt] OR (randomized[tiab] AND controlled[tiab] AND trial[tiab]))

Search terms for EMBASE

(“nurses”/de OR “health personnel”/de OR “nurse*”:ti,ab OR “nursing staff*”:ti,ab OR “registered nurse*”:ti,ab OR “health care personnel*”:ti,ab OR “healthcare personnel*”:ti,ab OR “health care worker*”:ti,ab OR “healthcare worker*”:ti,ab OR “health care professional*”:ti,ab OR “healthcare professional*”:ti,ab OR “health care staff*”:ti,ab OR “healthcare staff*”:ti,ab OR “health care provider*”:ti,ab OR “healthcare provider*”:ti,ab)
AND
(“work engagement”/de OR "work engag*":ti,ab OR engag*:ti,ab)
AND
(randomized:ti,ab AND controlled:ti,ab AND trial:ti,ab)

Search terms for CINAHL

(MH nurses OR MH “health personnel” OR TI nurse* OR TI "nursing staff*" OR TI "registered nurse*" OR TI “health care personnel*” OR TI “healthcare personnel*” OR TI “health care worker*” OR TI “healthcare worker*” OR TI “health care professional*” OR TI “healthcare professional*” OR TI “healthcare staff*” OR TI “health care staff*” OR TI “health care provider*” OR TI “healthcare provider*” OR AB nurse* OR AB "nursing staff*" OR AB "registered nurse*" OR AB “health care personnel*” OR AB “healthcare personnel*” OR AB “health care worker*” OR AB “healthcare worker*” OR AB “health care professional*” OR AB “healthcare professional*” OR AB “healthcare staff*” OR AB “health care staff*” OR AB “health care provider*” OR AB “healthcare provider*”)

AND

(MH “work engagement” OR TI "work engag*" OR TI engag* OR AB "work engag*" OR AB engag*)

AND

((TI randomized AND TI controlled AND TI trial) OR (AB randomized AND AB controlled AND AB trial))

Search terms for PsycINFO

(MA nurses OR MA “health personnel” OR TI nurse* OR TI "nursing staff*" OR TI "registered nurse*" OR TI “health care personnel*” OR TI “healthcare personnel*” OR TI “health care worker*” OR TI “healthcare worker*” OR TI “health care professional*” OR TI “healthcare professional*” OR TI “healthcare staff*” OR TI “health care staff*” OR TI “health care provider*” OR TI “healthcare provider*” OR AB nurse* OR AB "nursing staff*" OR AB "registered nurse*" OR AB “health care personnel*” OR AB “healthcare personnel*” OR AB “health care worker*” OR AB “healthcare worker*” OR AB “health care professional*” OR AB “healthcare professional*” OR AB “healthcare staff*” OR AB “health care staff*” OR AB “health care provider*” OR AB “healthcare provider*”)

AND

(MA “work engagement” OR TI "work engag*" OR TI engag* OR AB "work engag*" OR AB engag*)

AND

((TI randomized AND TI controlled AND TI trial) OR (AB randomized AND AB controlled AND AB trial))

Search terms for The Japan Medical Abstracts Society

("看護師"/TH OR "医療従事者"/TH OR “看護師”/TA OR “看護職”/TA OR “ナース”/TA OR “看護スタッフ”/TA OR "正看護師"/TA OR "ヘルスケアワーカー"/TA OR "ヘルスケアプロフェッショナル"/TA OR “ヘルスケアスタッフ“/TA OR "ヘルスケアプロバイダー"/TA) AND ("ワークエンゲージメント"/TH) AND (RD=ランダム化比較試験 OR ((“ランダム化”/TA OR “無作為化”/TA) AND “比較”/TA AND “試験”/TA))