

BMJ Open Effectiveness of posture-correction interventions for mechanical neck pain and posture among people with forward head posture: protocol for a systematic review

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To cite: Balthillaya GM, Parsekar SS, Gangavelli R, *et al*. Effectiveness of posture-correction interventions for mechanical neck pain and posture among people with forward head posture: protocol for a systematic review. *BMJ Open* 2022;**12**:e054691. doi:10.1136/bmjopen-2021-054691

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2021-054691>).

Received 19 June 2021
Accepted 02 February 2022



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ABSTRACT

Introduction Forward head posture (FHP) is the most common postural deviation of the upper back. It is believed to be one of the predisposing factors for the development of mechanical neck pain (MNP). We propose doing a systematic review to find the effectiveness of interventions targeted on FHP with MNP and assess implementation fidelity associated with these interventions.

Methods and analysis Medline (PubMed), Web of Science (Social Science Citation Index), EMBASE, Scopus, PEDro and CINAHL databases will be searched for studies published in English from their inception. Forward and backward citations of the included studies will be investigated for identifying additional records. We will include randomised controlled trials and non/quasi-experimental studies with two groups assessing the effectiveness of interventions targeted on FHP with MNP. Observational studies, non-randomised studies with single group and reviews will be excluded. We will consider the following outcome measures: postural variables of FHP, neck pain, performance-based functional disability scores of the neck, quality of life, basic activities of daily living and work-related outcomes. The unique citations will be screened by titles/abstracts and full texts, independently. The Cochrane Risk of Bias 2 tool will be used to critically appraise the included studies. The risk of bias and data abstraction of included studies will be undertaken independently. A qualitative synthesis will be conducted and, if sufficient studies with comparable outcome measures are available, we will statistically pool the result.

Ethics and dissemination We will undertake a systematic review of primary studies, and will not directly recruit participants hence, ethical clearance is not applicable. We will aim to present the findings of the completed systematic review at an international conference and subsequently submit the manuscript in a peer-reviewed journal for publication.

PROSPERO registration number CRD42021250310.

INTRODUCTION

‘Mechanical neck pain’ (MNP), also referred to as ‘non-specific neck pain’, is a commonly seen condition associated with head and

Strengths and limitations of this study

- This systematic review is the first of its kind that will comprehensively summarise and provide level of evidence on the effectiveness and implementation fidelity of posture-correction interventions on forward head posture with mechanical neck pain.
- We anticipate heterogeneity between different types of posture-correction interventions, duration of intervention and follow-up, and the definitions of mechanical neck pain and forward head posture that may affect pooling the result.
- Although this systematic review will search the literature comprehensively, due to language restriction and non-access to subscription-based databases, there is possibility to miss important studies that might be eligible to be included.

neck posture.¹ Kanlayanaphotporn *et al* used the following definition of MNP: ‘Pain primarily confined to the area on posterior aspect of the neck that can be exacerbated by neck movements or by sustained postures’.^{1,2} However, other researchers have used the definition of MNP with slight variations.¹ MNP is commonly associated with forward head posture (FHP).³ FHP is defined as excessive anterior positioning of the head in relation to a vertical reference line.⁴ Excessive anterior positioning of the head refers to ‘shift of reference point of head (external auditory meatus) in front of vertical reference line’.⁵ The vertical reference line is the line that passes through centre of gravity of human body in sagittal view.⁵ FHP is the most common cervical postural deviation in the sagittal plane.⁵

Plausible causes of the non-specific neck pain have not been completely understood.^{6,7} However, multiple factors are known



to be associated with pathomechanics of MNP, including structure and functions of related anatomical parts primarily that of the cervical and thoracic spine.⁷ Excessive anterior positioning of the head and/or reduced mobility of thoracic spine affects the cervical spine by altering mobility or affecting the key postural muscles.^{8,9} The key muscles affected by FHP are the serratus anterior, scapula elevators and trapezius that are attached to cervicothoracic spinal columns.^{8,9} Forward shift of head and neck due to prolonged flexed head position might cause postural defects in the sagittal plane and deficit in cervical range of motion, which affects balance or control of head leading to increased mechanical load and dysfunction.^{10,11} Postural changes as discussed above may be due to holding the neck in the forward bent posture for a long time or repeated movement of neck during work.¹² FHP is also associated with prolonged use of communication gadgets such as smart phones, computers and other infograms, which may further contribute to MNP.¹⁰

Neck pain, in general, causes considerable morbidity and affects activities of daily living and occupation.^{13–15} A subset of individuals with acute neck pain may eventually experience chronic or recurrent pain.^{13–15} FHP with MNP contributes considerably to the global neck pain burden; however, the actual data on the burden of FHP with MNP and other predisposing factors to FHP are lacking. As per a recently published global burden of disease study, globally, there were 288.7 million prevalent and 65.3 million incident cases of neck pain in 2017. The age-standardised point prevalence and incidence of neck pain were found to be 3551.1 and 806.6 per 100 000 persons, respectively.¹⁶ The burden of neck pain increases with the increasing age, with peak reaching in the age group of 45–54 years, after which it starts declining.¹³ Women (compared with men) reported a higher prevalence of neck pain in general.^{14,16,17}

There are various treatment modalities used for the improvement of FHP and MNP.^{18–20} For FHP, the interventions to improve posture include stretching of a specific group of muscles, strengthening of specific muscles, posture re-education techniques, workplace modifications, biofeedback techniques and application of external appliances to maintain the posture.^{9,18} Interventions primarily targeted to improve MNP include mobilisation techniques, manipulation techniques, soft tissue techniques, mechanical traction, electrotherapy modalities, stabilisation exercises, acupuncture, thermotherapy and cryotherapy.^{20–23} These interventions can be provided for the long duration in isolation or in combination to improve posture.¹⁸ Posture-correction interventions may improve FHP, which may result in improvement in MNP.

Various systematic reviews have been conducted among individuals with neck pain.^{19–23} There is evidence that therapeutic exercises resulted in improvement in neck range of motion, neck posture, neck pain and neck disability.¹⁹ Different interventions such as stretching exercises, global postural education, and cervical and thoracic mobilisations have been studied

for their effectiveness.^{19–23} Different interventions may have a specific role in posture correction, for example, stretching exercises may improve the flexibility of muscle and contribute to the improvement of posture.^{17,19} Global postural education programmes may address the posture of the whole body and also improve awareness of alignment of body segments.^{19,20} The joint mobilisation techniques may improve mobility of cervical and thoracic joints and are helpful to overcome hypomobility.²² Motor control training of deep cervical flexor muscles may improve joint stability and reduce neck pain.²³

The aforementioned evidence from systematic reviews suggests that the interventions may be beneficial for neck pain; however, these reviews^{19–23} were either conducted on a specific component of condition, for example, pain without considering the posture, or was limited to subcomponents of intervention, for example, therapeutic exercises. Furthermore, there is a dearth of information on the implementation fidelity of these interventions. To add to the existing knowledge pool and provide comprehensive and up-to-date evidence of the effectiveness of posture-correction interventions on MNP and posture among people with FHP, we have proposed a systematic review with the following research questions:

- What are the effective posture-correction interventions on FHP with MNP?
- What is the optimum duration and intensity of different types of interventions to correct FHP with MNP?
- What is implementation fidelity associated with the posture-correction interventions?

Conceptual framework

Prolonged and/or end range sitting posture, poor flexibility of muscles, muscle weakness and imbalance, and reduced mobility of joints are the immediate underlying factors associated with FHP. These factors may in turn be associated with an individual's occupation or lifestyle (eg, prolonged end range sitting posture) and age. Posture-correction interventions are the strategies that are designed to address the predisposing factors of FHP or FHP itself. These interventions may help by altering sitting posture, improving muscle flexibility, and changing the muscle strength and imbalance or mobility of joints. Change in FHP by these interventions may alter the mechanical loading and tissue irritation resulting in improvement in MNP. The relief from FHP and MNP may help in extending the individual's activities, reducing work absenteeism and subsequently improving quality of life. We have depicted the conceptual framework for the proposed systematic review with the help of a flow diagram (figure 1).

METHODS AND ANALYSIS

Review registration and reporting

The protocol for this systematic review was registered with the PROSPERO (CRD42021250310) on 28 May 2021. This review protocol has adhered to the Preferred

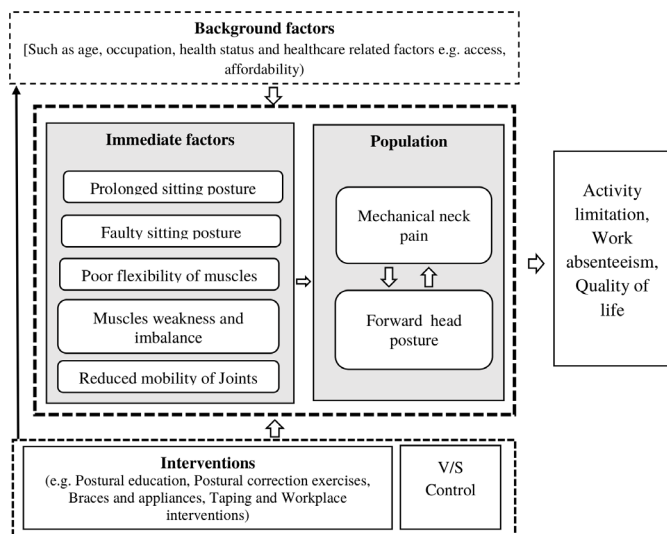


Figure 1 Conceptual framework of interventions for forward head posture with mechanical neck pain.

Reporting Items for Systematic review and Meta-Analysis Protocols guidelines.²⁴ In the event of any amendments to the proposed protocol, we will describe the change and justification for the same in the final review. We will follow the Cochrane Handbook for Systematic Reviews of Interventions to execute the review.²⁵

Eligibility criteria

The studies in this systematic review will be included based on the criteria listed below.

Types of study design

We will include non-experimental or quasi-experimental studies (follow-up interventional studies with two groups) and randomised controlled trials (parallel or crossover design), single or multicentre. Cluster trials are also eligible to be included provided they have considered a minimum of two each, intervention and control groups. Non-randomised studies (with single group pre-post), observational studies, case series, case reports and reviews will be excluded.

Types of participants

We will include individuals aged 18 years and above with FHP and MNP. We defined MNP as non-specific neck pain that is aggravated by sustained posture or movements. We have operationalised FHP as excessive anterior positioning of the head to a vertical reference line (plumb line) during relaxed sitting or standing position, where 'excessive anterior positioning of the head' refers to 'shift of reference point of head (external auditory meatus) in front of vertical reference line'.⁵ FHP could be of any duration but the participants should have had the MNP at least 12 weeks before conducting the trial. MNP could be self-reported by the participants or confirmed clinically. Studies of FHP associated with structural deformities, osteoporosis and pregnancy will be excluded. Studies on non-mechanical neck pain such as migraine,

fibromyalgia, whiplash injury and cervical radiculopathy will be excluded. Furthermore, this review will not consider studies that included individuals having terminal illness or who are bedridden. We will consider a mixed population (eg, all age groups), if the study has provided subgroup analysis for the population of our interest.

Types of intervention

Any interventions primarily targeted on FHP with MNP or associated factors such as thoracic posture, muscle tightness or muscle imbalance are eligible to be included. The interventions could be (but are not limited to) exercise, soft tissue techniques, manipulative and mobilisation techniques, education programmes, workplace interventions, ergonomic advice, and/or corrective braces or garments, or a combination of these. There is no restriction on the intensity, duration and provider of the intervention. The interventions could have been supervised (except educational) and delivered as one-to-one in person or via telecommunication mode. Non-supervised interventions are eligible to be included provided the participants are trained to undertake these effectively at home or in a community setting. In case of co-intervention, for example, standard care, if any, it should be equally distributed among all the arms of the study. Pharmacological interventions and complementary and alternative systems of medicine such as yoga, qigong and acupuncture will not be eligible to be included in this review. Interventions exclusively targeted to reduce the neck pain (with no secondary effect on the FHP) such as electrotherapy, shock wave, etc will be excluded. If the study has assessed the effectiveness of a complex or group of interventions (such as rehabilitation or non-pharmacological interventions), we will include it if it has a subgroup for the interventions of our interest, which are listed above.

Types of comparators

The postural correction interventions compared with no treatment, sham treatment, electrotherapy modalities, non-specific exercise programmes or standard care will be included. One posture-correction intervention compared with another type (eg, posture-corrective exercise vs posture-corrective educational programme), and same intervention with different intensities (eg, high intensity vs low intensity) or frequencies are also eligible to be included in this review.

Types of outcome measures

Primary outcome measures

(1) Any one of the postural variables of FHP will be included, for example, forward head angle, forward shoulder angle, cranial angle, craniovertebral angle, thoracic kyphotic angle, normalised scapular abduction ratio, and displacement measures of head or shoulder. These variables could have been measured using any outcome techniques/instrument such as the photogrammetric method, cervical range of motion device, inclinometer, goniometer or inch tapes. We will

consider studies irrespective of whether the reliability of the FHP outcome measures was provided, however, we plan to do a subgroup analysis for the measures that provided reliability data. (2) Neck pain measured using any patient-reported outcome measure (eg, numerical pain rating scale, visual analogue scale) and/or performance-based functional disability scores of the neck, for example, Neck Disability Index, Neck Pain and Disability Score.

Secondary outcome measures

Quality of life measured using any standard tool (could be generic or condition specific), basic activities of daily living and work-related outcomes such as absenteeism from work. We will also consider adverse events if reported by the included studies.

Setting and time frame

Studies conducted in clinical (hospital), community-based and workplace settings will be included. Studies should have a follow-up time of a minimum of 6 weeks to be eligible for inclusion.

Information sources and search strategy

The electronic databases Medline (PubMed), Web of Science (Social Science Citation Index), EMBASE, Scopus, PEDro and CINAHL will be searched from their inception to date of search. To find additional records, we shall search backward and forward citations of included studies and contact authors. To identify ongoing or newly completed studies, we will search clinical trial registries such as the International Clinical Trials Registry Platform Search Portal and ClinicalTrials.gov. Studies will be restricted to English publications but not publication status.

The databases will be searched by using predefined keywords, which include 'Medical Subject Headings'(MeSH) terms and common phrases. We have identified the following search concepts and text words: (1) Population: 'neck pain', 'mechanical neck pain', 'nonspecific neck pain', 'FHP', 'forward head posture', 'round back posture', 'forward shoulder head', 'forward head,' 'head alignment', 'neck alignment'; (2) Intervention: 'exercise', 'posture correction', 'movement therapy', 'strapping', 'exercise therapy', 'taping', 'physical therapy', 'corrective exercise', 'bracing; (3) 'randomized controlled trial', 'quasi-experimental study'. The 'AND' operator will be used between the concepts, while the 'OR' operator will be used within each keyword group. Modifications of keywords will be considered to account for alternate spelling. Initial search will be undertaken in Medline (PubMed) and subsequently, customised to be used in other electronic databases. We have drafted a preliminary search strategy for PubMed (online supplemental data), this will be reviewed by an information scientist and necessary modifications will be carried out.

Data management, study selection and extraction

Data management

Records of selected studies will be exported to EndNote V.X7 for data management and removing the duplicate records. The screening will be carried out using web-based software Rayyan-Intelligent Systematic Review, which helps in blinding the reviewers while screening the records. The data extraction and risk of bias of included studies will be carried out using a Microsoft Excel spreadsheet.

Study selection process

Two researchers, autonomously, will read each unique title and abstract to identify potential records. Similarly, we will review the full texts of the included retrieved articles. When an agreement on study selection between the researchers is not reached, there will be a discussion until consensus, or a senior member of the team, will act as an arbitrator and his/her decision will be final. We will prepare a detailed screening protocol to be followed by all the reviewers. The reasons for exclusion will be documented and the entire screening process will be depicted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 flow diagram.

In case of multiple publications arising from the single study, we will group the records as one study and consider the one with the longest follow-up for extraction and analysis to answer first and second research questions. To answer the third research question and complement the quantitative result, we will consider qualitative data, if available, from all the records/publications of included studies. The qualitative data could be extracted from formative evaluations, pilot studies, feasibility studies, process evaluations and mixed-methods analysis. To identify these records, the additional search will be carried out on Google Scholar, and included study funder's websites. Clinical trial registries will also be searched to find out linked records of the included trials.

Data extraction

Data will be abstracted from the included studies and entered into data collection forms, independently, by two reviewers. In case of any inconsistency regarding extracted data between reviewers, it will be conversed and resolved until consensus, and a senior member of the team will be involved/act as an arbitrator, if required, where his/her decision will be final. In case of incomplete or missing outcome information (which might restrict in calculating the effect sizes) from the included studies, requests will be made to the corresponding author by contacting via email. If there is no reply from the corresponding author within a fortnight, the team will decide based on available information whether to consider the study for analysis, or not.

The information extracted from selected studies will include study identifiers, publication status, details on study methods, study setting and geographical location, individual characteristics (eg, age, gender, duration of

MNP and FHP), sample size, outcome measures, time range of data collection and results (effect measures and corresponding 95% CIs). For extracting intervention-related data, we will consider a template for intervention description and replication or Template for Intervention Description and Replication checklist.²⁶ To ensure consistency in extracted data, the data abstraction form will be tested before its use and appropriately calibrated. In the case of crossover trials, to avoid the possible carryover effect, we will consider data only from the first period.

For the third research question, we will prepare a framework to code the qualitative data about the study. These may include context-specific information, facilitators and barriers to the implementation of interventions. Various implementation of fidelity-related information will be extracted such as information about the components of the intervention, dose or intensity, adherence to the intervention, process, quality and skills of intervention provision, and population responsiveness.

Risk of bias assessment of individual studies

This review will use the Cochrane Risk of Bias 2 (RoB 2) tool to critically appraise the included studies,^{27 28} independently, by two reviewers. The focus of this systematic review is to evaluate the effectiveness of assignment to intervention, that is, the 'intention-to-treat' effect. Considering this, we will select the appropriate second domain of the Cochrane RoB 2 tool. The RoB 2 rates the individual study in the following five domains: (1) randomisation process, (2) deviations from intended interventions, (3) missing outcome data, (4) measurement of the outcome and (5) selection of reported results. Within each domain, a reviewer will answer the series of signalling questions to get information about features of the trial that are relevant to the risk of bias.²⁹ Based on the answers to the signalling questions, judgement can be 'low risk', 'some concern' or 'high risk' of bias for each domain.²⁹ Similarly, overall risk of bias judgement of the study will be classified into 'low risk', 'some concern' or 'high risk' as per the criteria of the RoB 2.²⁹

Data synthesis

Study characteristics will be summarised using tables and narrative descriptive based on population, intervention, comparators, outcomes and study types (PICOS). Furthermore, the study findings will be grouped according to the type of interventions, comparator and outcomes. We will statistically pool the results, if the data are homogeneous in terms of PICOS. Meta-analysis will be undertaken using RevMan V.5.4.1. and generic inverse-variance approach will be considered. Summary effects such as risk ratio (categorical data) or mean difference (continuous data) will be calculated.³⁰ Forest plots will be used for depicting pictorial findings of the meta-analysis. We will calculate the design effect while pooling the result of cluster randomised trials.

Investigation for statistical heterogeneity will be performed by using I^2 statistics. A random-effect model

will be used in case of I^2 more than 50%; however, narrative synthesis is performed in case of substantial heterogeneity. If there is major variability in studies, we will explore likely justifications by carrying out a subgroup analysis. Subgroup analysis of different factors such as age (eg, less than and 50 years or higher age groups), gender, occupation, intervention types (which also includes interventions primarily focused to address MNP and secondary effect on posture), study design and outcome measure (type of measure and whether reliability data provided) will be carried out. Furthermore, to evaluate the robustness of study findings, we will explore the possibility of undertaking sensitivity analysis. To make sure we have identified all the studies for the particular outcome, we will explore the possibility of assessing reporting bias using a funnel plot or necessary statistical tests.

To answer the third research question, we will perform a manual thematic analysis. The extracted codes will be grouped to form code families and major themes will be generated. The demand-side and supply-side factors will be subcategorised under each theme.

Assessment of level of evidence

To provide reliable and transparent evidence, the strength of overall evidence will be weighed by using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach.³¹ The GRADE approach allows assessing certainty of body of evidence for relevant outcomes. It categorises selected outcomes into four levels: 'high', 'moderate', 'low' and 'very low'. Each outcome is assessed for five domains: these are 'risk of bias', 'inconsistency', 'indirectness', 'imprecision' and 'publication bias'.³¹ As suggested in the Cochrane Handbook, we will present the findings using a summary of findings table.³²

Patient and public involvement

We did not involve patients or the public at the stage of designing this systematic review protocol. However, we intend to share the findings of the final review with at least two patients of MNP with FHP and professionals working in the field of neck pain to receive their feedback for the final report. Professionals, affiliated to the authors' institution, will be used for convenience. Patients will also be chosen via a convenience sampling approach and should have English language skills.

Ethics and dissemination

We will undertake a systematic review of primary studies and will not directly recruit participants; as such, ethical clearance is not applicable. We will aim to present the findings of the completed systematic review at an international conference and subsequently submit the manuscript in a peer-reviewed journal for publication.

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Acknowledgements We are grateful to Manipal College of Health Professions (MCHP), Manipal Academy of Higher Education (MAHE), Manipal for providing logistic support and infrastructure to carry out this systematic review.

Contributors BKR is the guarantor of the review. GMB and BKR conceptualised and prepared the draft. RG, NP and SNB provided expertise in verifying the subject knowledge and SSP with that of the methods section. GMB and SSP drafted the search strategy. All authors have read, contributed to the revision and approved the final manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

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