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Research Article

Work an Unavoidable Pain in The Neck! Or Is It? A Systematic Review of Modifiable Risk Factors for Neck Pain in Office Workers

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Background

In modern, industrialized countries, service and information-based sectors are providing an increasing number of jobs [1-3]. Contemporary employment tendencies are becoming increasingly sedentary, leading to a growth in the office worker (OW) population [4,1]. The head and neck have been inculpated as the predominant painful body sites in OW [5]. Neck pain (NP) is defined as non-specific, mechanical, or soft-tissue-related pain (excluding serious pathologies' sequelae or disease, tumours, infection, and fractures) within the anatomical borders [6]. Studies have reported one-year prevalence of NP with exorbitances of 69% [7], compared to 37% within the general populace [8].

Occupational health services support employers and staff to manage work-related health, with specialist physiotherapists within the service. They aid work-related musculoskeletal disorders via physical treatments, preventative strategies regarding ergonomic advice, or exercise prescription for stress-management [9, 10]. Musculoskeletal disorders and stress form fundamental sickness absence rates [10], with 40% purportedly through musculoskeletal disorders such as NP amongst NHS employees [11]. NP corresponds with reduced work performance as it can reduce the ability to think and concentrate, which affects task engagement and results in productivity loss [1]. The COVID-19 pandemic has drastically metamorphosed working practices, as lockdown restrictions necessitated home environment changes for remote working [12, 13]. It has been identified that many home working environments possessed poor mental and musculoskeletal health and that 70.5% of participants reported current musculoskeletal pain – 23.5% in the neck. 50% of participants described that their symptom exacerbations related to their environmental alteration.

Plethoric research exists investigating work-related NP's mutuality with the environment's physical factors [14]. Prolonged sitting [15, 4], sitting in an unsupportive chair [16], and sitting in a bent, twisted, or sustained posture for prolonged periods [7] are all homologous with NP. Likewise, increased time working with computers [17-19] and using mice devices exacerbate risk [20]. However, as sitting is almost synonymous with computer-/keyboard-/mouse-work (unless working from a standing desk), it may be a case of unravelling the relative risk of each factor and whether standing desks cause similar symptoms. Further larger scale research which explores a range of ergonomic working practices using standard desks, treadmill desks, and standing desks would provide valuable insight regarding neck pain prevenances in the office workforce.

Psychological factors, such as stress [16, 1, 21], and states of psychological distress concerning anxiety and depression [17, 1] are substantially correlated with NP. Additionally, perceived muscle-tension, a key physiological indicator of psychological symptoms [22], is substantiated to correlate with NP amongst computer workers [19]. Among female office workers, minimal supervisor-support and excessive job- strain have been proposed to have positive affiliations with neck symptoms and disability [20], whilst applaudable supervisor-support, decision-authority and skill- discretion are protective [23].

This study's fundamental objective was to answer the research question 'What modifiable factors affect the risk of developing neck pain in office workers?'.

Methodology

This study was a systematic review based on secondary data, therefore only an ethical release statement was required. The study protocol was approved by PROSPERO (CRD, 2020), the International Prospective Register of Systematic Reviews (reg – CRD42020204484), and is presented per PRISMA guidelines [24]. A positivist epistemological stance was assumed to uncover objective cause-and-effect relationships [25].

Search Strategy

PubMed, Medline, Embase, CINAHL, AMED, PEDro and SPORTDiscus online database searches were conducted in August 2020 to identify all published, peer-reviewed literature from biomedical, physiotherapy, Allied Health, and nursing disciplines.

Relevant studies and reviews reference lists were hand-searched, and Google Scholar and Discovery were utilised to assist in the relevant literature's identification. Population, exposure, outcome (PEO) framework was utilised to dissect the research question into relevant subcomponents and combined with relevant Boolean operators, search criteria were constructed for each database.

Eligibility criteria

For inclusion, studies must have disseminated findings relating to NP development and preventable factor-exposure. Observational methods designed to surmise cause- and-effect relationships were prioritised, therefore only longitudinal studies were utilised in the final synthesis. Participants must OW over the age of 18, without any other demographic or occupational characteristic restrictions.

Study Selection

All identified articles were transferred to RefWorks for management and de- duplication by the lead researcher (MJ). The remaining articles were subject to a two-stage screening process (Figure 1) with a second researcher contributing (LB) to minify bias risk [26]. Through the eligibility criteria, stage one of the screening process involved reading titles and abstracts, whilst stage two involved obtaining full-text copies of remaining studies and reading them exhaustively. Consensus regarding screening result differences was resolved through constructive discourse. If a study was found to have used the same sample as another under consideration, one was discarded following discussion, with the study deemed to be most relevant included. If consensus was unattainable, a third researcher (JAs) was available to contribute to a majority vote.

Study Appraisal

The Critical Skills Appraisal Programme (CASP) tool for cohort studies was employed to assess eligible studies bias-risks [27]. However, a paucity of gold-standard appraisal tools for specific study designs or Allied Health-use exist [28], and CASP tools have been critiqued as limited in their ability to fully represent the complex, nuanced methodological considerations used within different studies [29], risking subjective bias. This was negated through an additional researcher (JA), and disagreement was negotiated using a third (JAs). Completed appraisal checklists are presented in Appendix 1.

Data Extraction

Relevant data-extraction was performed using two specifically prepared forms. The first, to note methodological factors (Appendix 2), including study-design, follow-up length/frequency, sample selection criteria, definitions used, risk factor analysis, and data-collection methods. The second, notes each study's sample characteristics, NP occurrence rates, and NP-associated factors (Table 1).

Table 1: Extracted results data.

Study	Sample Characteristics	Incident Cases	Associated Modifiable Factors
Eltayeb et al. (2009) [37]	Participants n=268 Drop-out = 2% Study population n=264 Female n=133 Male n=131 Mean age = Unreported	31%	-awkward head and body posture -irregular body posture -task difficulty -hours working with computer
Hush et al. (2009) [30]	Participants n=53 Drop-out = 0% Study population n=53 Female n=34 Male n=19 Mean age = 42 years	49%	-depression -anxiety -psychological stress -exercise 3+ times per week **Protective** -cervical flexion–extension >C120°

Jensen (2003) [35]	Participants n=3361 Drop-out = 33% Study population n=2576 Female n=1721 Male n=855 Mean age = 42 years	46.40%	**Unisex** - Frequent technical problems - high placed screen **Women** - high sensorial demands - low influence at work - high degree of repetitiveness - low social support - disturbance by glare **Men** - high cognitive demands - sufficient training in software use - good computer skills
Jun et al. (2020) [31]	Participants n=220 Drop-out = 13% Study population n=214 (a further 23 people excluded from risk factor analysis due to incomplete data) Female n=118 Male n=73 Brisbane n=139 Daegu n=52 Mean age = 37.3 years	Work related = 18.2% Non-work-related = not reported	- increased sitting hours during weekdays (work and home), - higher levels of job strain* - psychological stress* **Protective** - greater endurance of the cervical extensor muscles - greater cervical extension range of motion - higher levels of physical activity - higher control coping buffers job strain and psychological stress - higher social support buffers job strain and psychological stress - More time with neutral thorax posture (only with greater recorded endurance time of the cervical flexor muscles)
Korhonen et al. (2003) [33]	Participants n=232 Drop-out = 22% Study population n=180 Female n=80 Male n=100 Mean age = 47 years	Total = 34.4% Local=13.3% Radiating=14.4%	- poor physical work environment - poor keyboard placement - high stress + low physical activity
Paksaichol et al. (2015) [34]	Participants n=559 Drop-out = 4% Study population n=535 Female n=429 Male n=106 Mean age = 39 year	28%	- neck flexor endurance - desk and monitor height - typing style - perceived muscular tension - physical job demand
Shahidi et al. (2015) [32]	Participants n=171 Drop-out = 2.4% Study population n=167 Female n=132 Male n=35 Mean age = 30 years	21% chronic interfering neck pain (figure for non-chronic incidence not reported)	- depressed mood - high perceived stress **Protective** - greater cervical extensor endurance - more leisure physical activity - more efficient DNIC
Sihawong et al. (2016) [36]	Participants n=669 Drop-out = 8% Study population n=609 Female n=456 Male n=153 Mean age = 35.7 years	21.3% incident 16.8 of incident cases developed chronicity	**Risk factors for incident cases to develop chronicity** - body mass index - frequency of neck extension during the workday - psychological job demands.

Results

1669 articles were identified via systematically searching the databases. Manual and hand-searching yielded nil supplementary articles. Following duplicate-removal and screening, 13 articles remained. 3 articles were discarded through methodological factors not meeting inclusion criteria, and 1 was excluded through low methodological quality. 8 articles meeting inclusion-criteria were included in the final synthesis (Figure 1)

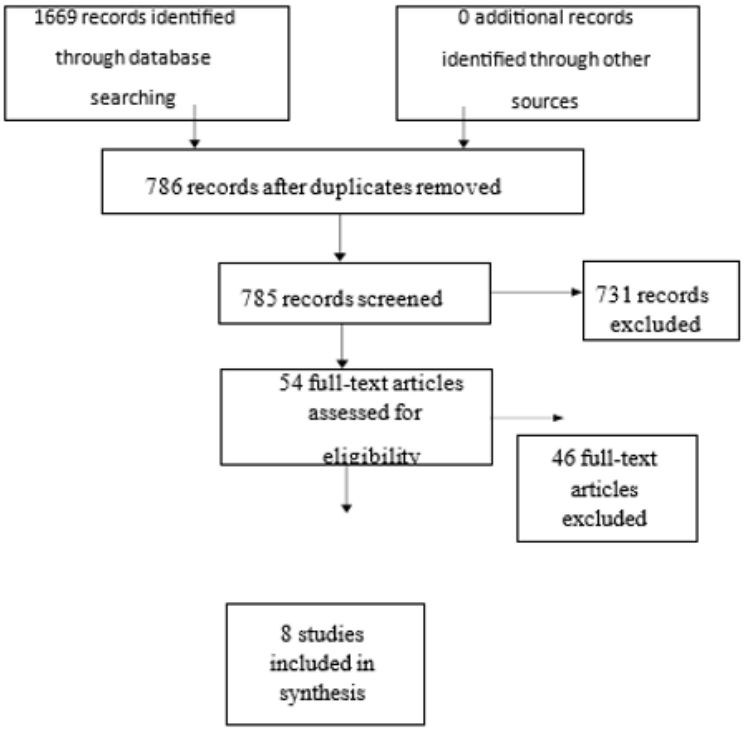

Figure 1: PRISMA Flow diagram of the study selection process.

Modifiable psychological factors

Intensified psychological stress increasing risk was divulged by three studies [30-32]. Korhonen et al. [33] reported finding a causative effect affiliated with high stress and inactivity. Paksaichol et al. [34] reported that perceived muscle-tension was predictive of NP development. Hush et al. [30] and Shahidi et al. [32] found an association with depression, anxiety and NP.

Modifiable work-social factors

Jensen [35] reported excessive cognitive demands and substandard technical support amongst men increased NP risk. In women, intolerable sensorial- stipulations, high-repetitiveness, low-influence, and inadequate social provisions elevated risk. Jun et al. [31] concluded that job-strain was related to increased-risk, however, high-control coping strategies and high social-support mediated this. Additional work-social factors include psychological job-demands [36], physical job- demands [34], and task difficulty [37].

Modifiable physical factors

Inappropriately-positioned computer monitors and keyboards were reported as physical risk factors [33-35]. Eltayeb et al. [37] reported factors relating to unsuitable posture-workstation interactions increased risk. Jun et al. [31] reported the risk-curtailing abilities of neutral thoracic posture and cervical flexor-endurance other physical factors increased computer-usage timescales [37].

Modifiable biomechanical factors

Greater cervical extensor-endurance has been considered preventative in the development of NP [31], whilst atrophic neck flexor-endurance was causative [34]. Whereas Sihawong et al. [36] advocated that neck extension-frequency throughout the workday increased neck pain association. Risk-reduction was purportedly interconnected with improving cervical-extension range-of-motion by Jun et al. [31], and cervical flexion and extension range surpassing 120° by Hush et al. [30]. Paksaichol et al. [34] postulated that typing technique was a contributing factor in the development of neck pain.

The role of physical activity

Higher physical activity levels have been shown to reduce the risk of neck pain in office workers [31, 32]. Korhonen et al. [33] reported that office workers with higher levels of physical activity correlate with reduced stress levels and when compared

to sedentary office workers, they were seven times more at risk of developing neck pain compared to highly active and extremely stressed office workers. Conversely, Hush et al. [30] reported that those exercising a few times a week had greater NP- occurrence risk. Furthermore, those who did exercise three times a week were also reported to spend considerable time working in a seated position and it was those sedentary behaviours that increased the risk of neck pain according to Jun et al. [30].

Discussion

The results demonstrate how work-social factors affect psychological stress, consequentially provoking neck pain development. Modifiable factors regarding physical environment, individuals' physical capacities and activity profiles have been found. Psychologically, OW NP is associated with stress [1, 16, 21], general psychological distress [17], anxiety and depression [1] and perceived muscle-tension [19]. This data contained self-reported psychological symptoms therefore it may be susceptible to bias. Future research which uses a professionally assessed medical diagnosis will improve the robustness of the key findings.

Muscular tension was highlighted as causative of OW neck and shoulder pain by Huysmans et al. [38]. However, laboratory-based findings do not associate objectively measured muscular tension with pain. Stress/pain reporting is also more likely by those experiencing muscle-tension, perhaps resulting from other factors.

Consequently, objective determination that stress within office scenarios influences muscle-tension, and NPs are recommended.

Kraatz et al. [39] exhibited compelling evidence for job-demands, -control, -strain and social-support relationships in general working populations. NP-variable correlations of various work related demands [40], include control [41], support [23], and strain [41]. OW may avoid reporting negative work-social facture for fear of repercussions which may further increase stress. Preventative strategies focused on reducing job-strain, demand, and optimising job-control and social-support could reduce social domain's detrimental repercussions.

OW have more risk of having NP if they are more physically active [4], with elevated vulnerability in less active [21], and sedentary populations [4, 15]. Sitthipornvorakul et al. [42] reported that those working sedentary jobs could minify NP's risk by 14% by increasing their physical activity via walking 1000 steps-per-day. Opposing to this, Blangstead et al. [43] stated that all-round training (cardiopulmonary-focused exercise) did not precipitate protective OW neck and shoulder symptom effects.

Hildebrandt et al. [44] reported that certain 'vigorous' sports retained increased risk. This infers that the physical activity modality is influential and may account for this review's contradictory finding that exercising 3+ times-per-week increases risk.

Physiotherapists are perfectly placed to inhibit NP via exercise intervention. Wu et al. [45] found a dose-response relationship between exercise frequency and resistance to job-stress. Workplace exercise interventions such as yoga [46], outdoor aerobic/strength [47], and tai chi [48,49] have demonstrated positive effects on stress.

Inappropriately set computer monitors as a cause of NP is well recognised [50]. Some studies have used unclear or undefined measures of optimal/sub-optimal. For example, Jensen [35] reported that having a high-placed screen was causative, whilst Paksaichol et al. [34] did not specify high/low positioning specifically. These inconsistencies necessitate a wider study area to aid more indisputable understandings.

Low-placed screens significantly increase neck loading [51] and muscle-activity [52]. Prolonged neck-flexion is also associated with NP in OWs and NP's association [16]. Muscle-strain with cervical extension has also been associated with high-placed screens [53]. Future research is warranted to determine whether optimal screen-height interventions prevent the onset of NP.

NP is purportedly associated with reduced activity, strength and/or endurance of cervical-extensors [32, 54, 55], -flexors [56-58] and reduced force-production capacity in all motional planes [57]. Furthermore, minimal neck/shoulder physical capacity was found as an NP risk factor by Hamberg-van Reenen [59]. Falla et al [57, 59] studies investigating cervical-flexor musculature ascertained that pain- inducing neck postures amongst computer-users are rectifiable.

Sihawong et al. [36] preventative intervention study integrated static stretches and muscle-activation to significantly improve neck flexor-endurance and cervical- mobility, which reduced NP cases by 55%. This suggests that tight/weak muscular structures are analogous with NP. Future research determining why cervical-biomechanical structures affected are compromised would benefit the evidence base. Physiotherapists are perfectly placed to contribute to NP prevention by leading interventions aimed at improving cervical-biomechanical efficiency.

Strengths And Limitations

The methodology was approved by PROSPERO [60, 61] before inception to increase credibility. The process was characterised by elements via systematic search process, additional researchers contributed to screening and appraisal, and implemented a vindicable appraisal tool. It adhered to PRISMA guidelines, increasing robustness. This produced eight high-quality studies' synthesis, with high ecological validity and conclusions of cause-and-effect with clinical implications.

The search was limited to studies published in English, possibly creating publication bias. The CASP appraisal tool was found by both appraisers to rely on subjective interpretation, referring to both the guidance for use and checklist items. This was reflected in different appraiser responses, despite results being broadly similar, the tool also uncovered a lack of representative samples, which, percase, limits the conclusions' practical applications. Finally, the synthesised studies incorporated significant methodological heterogeneity, perhaps explaining the studies' widely varied results, possibly influencing the conclusions reached here. Therefore, future research is required to confirm the proposed assertions.

Conclusion

OW are exposed to specific factors that promote NP's development. Discernment of these factors may assist in NP's prevention and treatment. Contemporary trends towards office work, and the potential for large workforce exposure to similar risk factors, following the necessitated homeworking during the Covid-19 pandemic, denotes that substantial quanta of the working population may be at risk of developing avoidable NP.

This review has explored modifiable risk factors to address NP's negative effects. Evidence exists that psychological factors vis-à-vis stress and distress may be decisive causative factors, potentially influenced by work-social factors apropos job- demands, -control, -support, and -strain. Auspiciously, physiotherapeutic advice, exercise recommendations, and general physical activity may yield preventative effects against psychologically induced NP. Physiotherapists, including those within occupational health, are ideally situated to prevent and treat OW NP.

The evidence infers that incongruously positioned screens have causative sequelae, perhaps due to neck angle-related ramifications. Although heterogeneity exists concerning what height is inappropriate, there appears to be a consensus that screen tops should be at eye-level. Furthermore, the finding that sub-optimal cervical biomechanics are causative, strengthens the evidence base. With consideration of the studies' limitations, the findings of this review may contribute to further scientific enquiry and evidence-based OW NP prevention and treatment stratagems inaugurations.

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Conflict of Interest

There are no conflicts of interest.

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APPENDIX

Appendix 1:

Marc Johnson – First appraiser													
Study	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome measure accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Have they taken account of the confounding factors in design and/or analysis?	Was the follow up of subjects complete enough?	Was the follow up of subjects long enough?	Do you believe the results?	Can the results be applied to the local population?	Do the results of this study fit with other available evidence?	What are the implications of this study for practice?	Total score/12
Eltayeb et al. (2009) [37]	Y	Y	Y	Y	Y	U	Y	Y	Y	N	Y	Y	10/12
Hush et al. (2019) [30]	Y	Y	Y	Y	Y	U	Y	Y	Y	N	Y	Y	10/12
Jensen (2003) [35]	Y	Y	Y	Y	Y	N	U	Y	Y	N	Y	Y	9/12
Jun et al. (2020) [31]	Y	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	Y	11/12
Korhonen et al. (2003) [33]	Y	Y	Y	Y	Y	Y	U	Y	Y	N	Y	Y	10/12
Paksaichol et al. (2015) [34]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	11/12
Shahidi et al. (2015) [32]	Y	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	Y	11/12
Sihawong et al. (2016) [36]	Y	Y	Y	Y	Y	U	Y	Y	Y	U	Y	Y	10/12
Jill Alexander – Second appraiser													
Study	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimise bias?	Was the outcome measure accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Have they taken account of the confounding factors in design and/or analysis?	Was the follow up of subjects complete enough?	Was the follow up of subjects long enough?	Do you believe the results?	Can the results be applied to the local population?	Do the results of this study fit with other available evidence?	What are the implications of this study for practice?	Total score /12
Eltayeb et al. (2009) [37]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	11/12
Hush et al. (2009) [30]	Y	Y	Y	Y	U	U	Y	Y	Y	N	Y	Y	9/12
Jensen (2003) [35]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	11/12

Jun et al. (2020) [31]	Y	Y	Y	Y	U	Y	Y	Y	Y	N	Y	Y	10/11
Korhonen et al. (2003) [33]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	11/12
Paksaichol et al. (2015) [34]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	11/12
Shahidi et al. (2015) [32]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	11/12
Sihawong et al. (2016) [36]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	11/12

Appendix 2:

Study	Study design	Participant follow-up	Sample Selection	Definition of Incidence	Factors in univariate and/or multivariate analysis	Data Collection
Eltayeb et al. (2009) [37]	Prospective cohort study	Once, 2 years following inception	Population – computer office workers from – single public sector organisation in the Netherlands Eligibility criteria not reported.	Neck = unclear Incident case = the occurrence of neck complaints with a duration of at least 1 week during the previous 12 months.	- Computer working hours/day - Previous history of complaints - Equipment position - Personal computer placement - Awkward body posture - Irregular head and body posture - Decision authority - Skills discretion - Job pressure - Task difficulty - Social support - Work flow - Job strain	Self-reported
Hush et al. (2009) [30]	Prospective cohort study	Every 2 weeks for 1 year	Population – university office workers from – single university in Australia Eligible if employed or studied full-time, performed mainly sedentary work, spoke/read English and were aged 18-60 years. Excluded if they had current neck pain or any diagnosed disease affecting the cervical spine (e.g rheumatoid arthritis), anticipated prolonged absence from work during follow-up period, or an episode of care for neck pain in the past 3 months.	Neck = Standardised Nordic definition Incident case = the occurrence of neck ache, pain, or discomfort lasting more than 24 hours during the follow-up period	- Age - Female gender - Total duration sitting - Duration sitting before break - Exercise frequency - Cervical flexion–extension - Cervical lateral flexion - Cervical rotation - Cervical protraction - Cervical extensor endurance - Psychosocial work factors - Depression - Anxiety - Psychological stress	Mix of self-reported and researcher assessed

Jensen (2003) [35]	Prospective cohort study	Once, from 17-23 (mean-21) months following inception	Population – computer workers From – multiple (n=11) corporate organisations in Denmark Eligibility criteria not reported, but participants were excluded from analysis if symptomatic (symptoms for 7+ days within the last year)	Neck = Standardised Nordic definition Incident case = trouble, ache, or pain for more than 7 days during the last year.	- Age - Previous symptoms - Duration of employment in the same job - Experience with computer use - Quantitative demands - Cognitive demands - Sensory demands - Influence at work - Developmental possibilities - Repetitiveness - Social support - Training in software use - Computer skills - Technical problems with computer - Quality of technical support - Space for arm support near keyboard - Screen height relative to eye-level - Disturbed by glare - Worktime at computer - Worktime using mouse	Self-reported
Jun et al. (2020) [31]	Prospective cohort study	Every month for 1 year	Population – office workers From – multiple (n=unclear) organisations, mainly universities, in Brisbane, Australia, and Daegu, South Korea Eligible if 18 years+, employed in full time office work (30 hours+ per week) including computer intensive work for 20 hours+ per week, reported an absence of interfering neck pain, or pain in the shoulder, thorax, or lower back, or other symptoms (ache, tingling, numbness, and discomfort) for 1 day or greater during the previous 12 months.	Neck = BJDTF definition Incident case = 'interfering neck pain'* for 1 day or greater during the follow-up period.	- Age - Gender - BMI - Physical activity - Time sitting during weekdays (work/home) - Cervical flexor endurance time - Cervical extensor endurance time - Mouse location - Time in neutral thorax posture - Active cervical extension ROM - Job strain - Social support - Escape coping - Control coping - Stress symptom	Mix of self-reported and researcher assessed

Korhonen et al. (2003) [33]	Prospective cohort study	Once, 1 year following inception	Population – office workers from – multiple (n=3) public sector organisations in Finland Eligible if working full time in a role included VDU work for more than four hours per week and reporting local or radiating neck pain for less than eight days during the preceding 12 months.	Neck = unclear Incident case = local or radiating neck pain for 8+ days during the preceding 12 months.	- Sex - Age - Smoking - Frequency of physical exercise - Health status - Mental stress - Mental strain - Depression - Job satisfaction - Time used for domestic activities - Time used for hobbies - VDU working time - Physical work environment - Ergonomics of workstation - Distance of the screen - Height of the screen - Distance of the keyboard - Deviance of the keyboard - Distance of the mouse - Deviance of the mouse - Breaks during work - Influence on workload	Self-reported
Paksaichol et al. (2015) [34]	Prospective cohort study	Every month for 1 year	Population – office workers From – multiple (n=4), 1x university/3x public sector organisations in Bangkok, Thailand Eligible if 18–55 years old, working full-time. Ineligible if reporting neck pain in the previous three months, pregnancy (or planned within 12 months), history of trauma, accidents, or surgery in the neck region, had been diagnosed with fibromyalgia, carpal tunnel syndrome, cervical radiculopathy, systemic illness or connective tissue disorders, or planned to be on vacation more than 9 consecutive days in the next 12 months.	Neck = Standardised Nordic definition Incident case = neck pain lasting >24 hours, of an intensity >30 mm on a 100mm visual analogue scale (VAS), without weakness or numbness in the upper limbs.	- gender - history of neck pain and back pain - neck flexor endurance - desk and monitor height - typing style - perceived muscular tension - physical job demand *factors in multivariate analysis. Data from univariate analysis not reported	Mix of self-reported and researcher assessed

Shahidi et al. (2015) [32]	Prospective cohort study	Every month for 1 year	Population – office workers From – Denver (US) metropolitan area Eligible if 18 to 65 years old, within 3 months of hire in a new job requiring them 30+ hours per week in an office including computer use 75+% of workday, reported no neck pain or neck-related disorders during the previous year, and reported a score of <5 points on the NDI, including absence of cervical/shoulder/cranial pathology during a physical examination. Ineligible if history of fibromyalgia or musculoskeletal pain present in 4+ body regions concurrently, self-reported systemic illness, previous cervical/shoulder surgery, acute neck/shoulders injury, untreated psychiatric condition, uncontrolled hypertension, pregnancy, or inability to type/comprehend written/oral English.	Neck = BJDTF definition Incident case = 'interfering neck pain' Chronicity = reporting of an incident case for 3 or more months during the 12-month follow-up period	- forward head posture - cervical AROM - cervical isometric strength - cervical endurance - scapular isometric strength - scapular muscle length - routine physical activity - job-related physical strain - depressed mood - generalised anxiety - perceived stress -catastrophisation - job satisfaction - job-related mental strain - cold pain threshold - cold pain tolerance - DNIC (diffuse noxious inhibitory control)	Mix of self-reported and researcher assessed
Sihawong et al. (2016)	Prospective cohort study	Every month for 1 year	Population – office workers from – multiple (n=9) in corporate organisations in Bangkok, Thailand Eligible if 18-55 years old, working full time. Ineligible if reporting musculoskeletal symptoms in the spine in the previous 3 months, pregnancy (or planned within 12 months), history of spinal trauma/accidents, history of spinal, intra-abdominal, or femoral surgery in the previous 12 months, congenital anomaly of the spine, rheumatoid arthritis, spinal/disc infection, ankylosing spondylitis, spondylolisthesis, spondylosis, tumor, systemic lupus erythematosus, or osteoporosis	Neck = Standardised Nordic definition Incident case = neck pain lasting >24 hours, of an intensity >30 mm on a 100mm visual analogue scale (VAS), without weakness or numbness in the upper limbs. Chronicity = ongoing neck pain for at least 3 months in any 6 months during the 1-year follow up.	- Gender - Age - BMI - Frequent neck extension during workday - Initial pain intensity - initial disability level - psychological job demands *factors in multivariate analysis of those leading to chronicity. Data on univariate analysis and risk for incident cases not reported	Mix of self-reported and researcher assessed