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Psychosocial, Physical, and Neurophysiological Risk Factors for Chronic Neck Pain: A Prospective Inception Cohort Study

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Abstract: **The purpose of this investigation was to identify modifiable risk factors for the development of first-onset chronic neck pain among an inception cohort of healthy individuals working in a high-risk occupation. Candidate risk factors identified from previous studies were categorized into psychosocial, physical, and neurophysiological domains, which were assessed concurrently in a baseline evaluation of 171 office workers within the first 3 months of hire. Participants completed monthly online surveys over the subsequent year to identify the presence of chronic interfering neck pain, defined as a Neck Disability Index score ≥5 points for 3 or more months. Data were analyzed using backward logistic regression to identify significant predictors within each domain, which were then entered into a multivariate regression model adjusted for age, sex, and body mass index. Development of chronic interfering neck pain was predicted by depressed mood (odds ratio [OR] = 3.36, 95% confidence interval [CI] = 1.10–10.31, *P* = .03), cervical extensor endurance (OR = .92, 95% CI, .87–.97, *P* = .001), and diffuse noxious inhibitory control (OR = .90, 95% CI, .83–.98, *P* = .02) at baseline. These findings provide the first evidence that individuals with preexisting impairments in mood and descending pain modulation may be at greater risk for developing chronic neck pain when exposed to peripheral nociceptive stimuli such as that produced during muscle fatigue.**

Perspective: ***Depressed mood, poor muscle endurance, and impaired endogenous pain inhibition are predisposing factors for the development of new-onset chronic neck pain of nonspecific origin in office workers. These findings may assist with primary prevention by allowing clinicians to screen for individuals at risk of developing chronic neck pain.***

Key words: *Neck pain, chronic, prospective, risk factors.*

Neck pain ranks as the fourth greatest contributor to global disability[31] and affects 30 to 50% of the general population,[30] with an even greater prevalence among individuals in high-risk occupations. For example, up to 63% of office workers report at least 1 episode of neck pain, with 14% indicating significant activity limitations.[16,27] Most of those who experience an acute episode of neck pain report either persistent (37%), recurrent (23%), or worsening (10%) symptoms up to 12 months later.[15] Individuals who develop chronic neck pain respond poorly to treatment and consume a disproportionate share of health care resources.[9,45] Furthermore, reduced productivity attributed to neck pain and other musculoskeletal disorders in the workplace has been estimated to cost $61.2 billion annually.[60] Recent systematic reviews of longitudinal and case-control studies have reported numerous and often inconsistent risk factors for neck pain.[18,48] As a result of this heterogeneity, no widely accepted conceptual framework currently exists to guide research on the primary prevention of this prevalent and costly disorder.

To better understand how multiple factors may contribute to increased risk of chronic neck pain, we

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reviewed the literature to identify candidate risk factors in the psychosocial, physical, and neurophysiological domains. These domains encompass previously reported impairments in 1 emerging (neurophysiological) and 2 established (psychosocial and physical) areas of investigation that can be targeted for primary prevention in future studies. In the psychosocial domain, job-related and general measures of psychological health have been shown to predict long-term symptoms and disability associated with existing neck pain; however, the strength of the relation between psychological health and new-onset musculoskeletal pain is much smaller.[40] Although cross-sectional studies commonly report that depression, anxiety, and catastrophization are higher in those with existing pain,[22,29,53] this observation cannot rule out the possibility that persistent pain perpetuates poor mood.[44]

In the physical domain, job-related exposures including poor ergonomic positioning and high physical strain have been suggested to increase the risk of neck pain[1,2,20]; however, a systematic review found only limited or conflicting evidence from prospective studies to support most of these risk factors among office workers.[48] Limited data from cross-sectional investigations suggest that more general physical characteristics such as routine physical activity and impairments in cervicoscapular strength, mobility, and endurance may also be associated with neck pain,[2,52] yet most of these physical characteristics have not been investigated prospectively.

In the neurophysiological domain, recent evidence has shown alterations in pain processing that result in localized and widespread hypersensitivity to mechanical stimuli in individuals with neck pain compared with pain-free controls.[1,53] Diffuse noxious inhibitory control (DNIC) is also thought to be impaired in individuals with chronic pain compared with healthy individuals[39]; however, it is not known whether alterations in endogenous pain inhibition are present before or as a consequence of persistent pain.

Most prospective investigations to date have included participants with a previous or ongoing history of neck pain, precluding identification of causal factors for the initial onset of pain.[48] In addition to previous pain episodes, the most consistently reported risk factors for neck pain include increasing age and female sex.[43,48] However, these factors cannot be modified and are unlikely to inform prevention and management strategies to reduce the socioeconomic and personal costs of neck-related disability. No study has prospectively examined whether preexisting neurophysiological factors account for additional risk when considered with more established physical and psychosocial risk factors within the same cohort. Therefore, the purpose of this investigation was to identify modifiable psychosocial, physical, and neurophysiological risk factors for the initial onset of chronic, nonspecific neck pain in a healthy cohort of office workers.

Methods

Participants

Participants 18 to 65 years of age were recruited by convenience sampling from the Denver metropolitan area through print and radio advertisements, new employee orientations, and employee bulletins and flyers posted by local businesses. All participants were within 3 months of their date of hire in a new job that required them to work ≥30 hours per week in an office setting with the use of a computer for at least 75% of the workday. They reported no neck pain or neck-related disorders during the previous year and were screened for the absence of cervical pathology during a physical examination (see exclusion criteria). To minimize the potential for selection bias due to poor recall of pain symptoms, the Neck Disability Index (NDI) was used to screen for activity limitations caused by pain during the previous year, which are more likely to be remembered than noninterfering neck pain. Individuals with no signs or symptoms of cervical pathology who reported a score of <5 points on the NDI were eligible for participation.

Exclusion criteria included 1) objective signs of structural pathology on physical examination, including but not limited to shoulder bursitis, impingement, tendonitis, fracture, cervical nerve or disc impairment, radiculopathy, or loss of upper extremity sensory or motor function; 2) history of fibromyalgia or musculoskeletal pain present in more than 4 body regions concurrently; 3) self-reported systemic illness including cancer, rheumatic, cardiovascular, or neurological disease; 4) previous surgery involving the cervical spine or shoulders; 5) acute (<12 weeks before the study) injury of the neck or shoulders; 6) untreated psychiatric condition; 7) uncontrolled hypertension (resting systolic blood pressure >150 mm Hg, or diastolic blood pressure >90 mm Hg); 8) pregnancy; and 9) an inability to type or comprehend written and oral instructions in English. All procedures were approved by the local institutional review board and informed consent was obtained from every participant.

Baseline Assessment

A 2- to 3-hour baseline assessment was performed for each participant within the first 3 months of hire in an occupation placing them at high risk for the development of neck pain. Data were collected on established personal risk factors for neck pain, including age, sex, body mass index (BMI), and smoking history.[43,48,49] Descriptive characteristics of the study sample were also surveyed, including marital status, education level, race/ethnicity, and general medical history. As detailed below, candidate predictors were categorized into psychosocial, physical, and neurophysiological domains based on a theoretical construct derived from existing longitudinal and case-control studies. Fig 1 illustrates the candidate measures that were collected during the baseline assessment for risk analyses within each of the primary measurement domains. In addition to these