**TITLE PAGE**

**Title:**

Factors Associated With Physical Activity Participation In Adults With Chronic Cervical Spine Pain. A Systematic Review.

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**ABSTRACT**

OBJECTIVE:

To determine the factors associated with physical activity participation in adults with chronic cervical spine pain.

METHODS:

A systematic review was conducted including searches of PubMed (MEDLINE), EMBASE and CINAHL from inception to June 12th 2016. Grey literature and reference checking was also undertaken. Quantitative studies including factors related to physical activity participation in adults with chronic cervical spine pain were included. Two independent authors conducted the searches, extracted data and completed methodological quality assessment.

RESULTS:

A total of 7 studies met the selection criteria, however, four papers were finally included in the final review. A modified Downs and Black criteria was used to assess methodological quality, each study included was classed as moderate quality. A total of 6 factors were assessed against physical activity participation for subjects with chronic neck pain. These included; pain, fear of movement, smoking habits, socioeconomic status, gender, leisure and work time habits. A significant relationship was demonstrated between pain, leisure and work time habits and physical activity. Subjects were less likely to participate in physical activity if they were in pain. Subjects with neck pain were less likely to participate in physical activity in their leisure and work time.

CONCLUSION:

Pain, fear of movement, smoking habits, socioeconomic status, gender and leisure and work time habits are all factors for physical activity participation in people with chronic cervical spine pain. This is based on a small number of heterogeneous studies. Pain, leisure and work habits were statistically significant. Recommendations on future research are made.

**Contribution of paper**

* No systematic literature review to date has determined what factors are associated with physical activity participation in adults with chronic cervical spine pain
* Pain, fear of movement, smoking habits, socioeconomic status, gender and leisure and work time are factors associated with physical activity participation for patients with chronic cervical spine pain.
* There were a small number of heterogeneous studies and further research recommendations have been made.

**Key Words:**

Physical Activity; Neck Pain; Physiotherapy

**MANUSCRIPT**

**INTRODUCTION**

Neck pain is a common musculoskeletal condition with a point prevalence ranging from 20.6% to 22.2% (1, 2). Up to 50% of people with neck pain are categorised as "chronic" with pain and subsequent disability lasting more than three months (3). Importantly, patients with chronic musculoskeletal conditions demonstrate poorer mental health status (4) and a reduction in functional activity and social participation (5), which have been shown to negatively impact on health status and overall management of their condition and prognosis. Chronic neck pain patients often report difficulties in relation to performance of daily activities (6) and present with psychological factors such as stress and anxiety, which are strongly associated with increased pain and disability (7). Therefore management strategies aiming to address overall ‘*illness’* management, disability and health status of this group of patients may have greater effectiveness than local treatment addressing the underlying cervical pathology alone.

Conservative management for neck pain may include uni-modal or multi modal strategies such as advice, education, manual therapy and exercise prescription (8, 9). Therapeutic exercise prescription may be in the form of specific stretching, ‘postural’ or strengthening programmes targeted locally at the cervical spine, which can provide short term improvements in pain and function (10, 11). However, a world-wide neck pain task force suggests that physical activity may provide greater efficacy and effectiveness in restoring physical function and managing the psychological components of chronic neck pain such as anxiety and depression (1, 12).

Physical activity (PA) is defined as any bodily movement that requires energy expenditure (13). It is suggested that PA may be sub-grouped into three categories including active transport (for example, walking from home to work), active living (for example, gardening, housework) and sports and exercise (13-15). Public Health England (PHE) reports that if primary healthcare practitioners, society and individuals can improve the adherence to PA guidelines (14) then important health benefits can be achieved for sufferers of chronic conditions such as cardiovascular disease, mental health and osteoporosis (14-16). Moreover, physical inactivity has been strongly associated with the development and exacerbation of chronic health problems, including diabetes mellitus, ischemic heart disease, stroke, breast cancer, colon/rectal cancer and chronic musculoskeletal complaints (15, 17).

The reasons why the general public or patients participate in PA are complex. It is reported that there are multiple factors that can influence why patients choose to participate in PA in long-term musculoskeletal conditions such as osteoarthritis, including social support, economic costs, access to facilities, disease related and psychological factors (18). A previous literature review investigating the association between levels of physical activity and neck pain reported that there is conflicting evidence based on a low number of heterogeneous studies (19). However, this review did not specifically investigate possible factors that may or may not influence neck pain patient’s participation in PA. There is some evidence supporting favourable outcomes in patients with neck pain that participated in PA and demonstrated active lifestyles (20-22). Identifying factors that influence participation in PA may assist in the development of effective management strategies for not only localised neck pain but overall '*illness'* management in regards to disability, physical function and psychological well-being.

To date no systematic reviews been undertaken to determine what factors are associated with PA participation in adults with chronic cervical spine pain. The aim of this study is to undertake a systematic review to establish factors that influence participation in PA in patients with chronic neck pain.

**METHODS**

The systematic review was registered with PROSPERO review database (Ref: CRD42015027970), and completed following the PRISMA guidelines of reporting (23).

Search Strategy

One reviewer (MM) conducted the systematic search of electronic databases PubMed (MEDLINE), EMBASE and CINAHL from inception to June 12th 2016. An example of the MEDLINE search strategy can be found in Appendix 1. An unpublished (grey) literature search and trial registry search was also completed (Appendix 2). A hand search was completed of the reference lists of the records screened for potential inclusion. Finally, the corresponding authors from all included studies were contacted to determine if there were any pending article publications in this area or unpublished work. Two reviewers (MM, TS) conducted the inclusion and exclusion of studies; at the eligibility stage of selection the reviewers conducted a reliability assessment of the eligibility criteria using a weighted Kappa statistic (Supplementary Table 1). There was almost near perfect (0.85) agreement.

Eligibility Criteria

Studies were included if they met the following criteria:

1. Any quantitative study type
2. Adult subjects (over 18 years) with cervical spine pain lasting more than 3 months, including non-specific cervical spine pain or whiplash associated disorders (Modified Quebec task force grade equal or less than IIc) (24).
3. The dependent variable being physical activity participation

Any outcome measure capturing PA was considered for inclusion. No limitation of publication date was applied. All considered articles had to be in the English language. Articles were excluded if PA adherence was not measured or if the participants’ cervical spine pain was related to systemic pathology, fracture, radiculopathy, myelopathy or upper motor neurone pathology.

Study Identification

Using the eligibility criteria, the titles and abstracts of all search results were independently reviewed by two reviewers (MM, TS). From this, full text articles from potentially eligible articles were retrieved and independent assessment was completed by the two reviewers. Final eligibility was decided based on full-text assessment.

Data Extraction

Data were extracted onto a pre-defined data extraction table independently by two reviewers (MM, TS). Data extracted included: study characteristics, study type (setting and design), subjects (number, age, gender, duration of symptoms) and details of cervical spine diagnosis. Corresponding authors were contacted to seek clarification or to request additional information on the data sets.

Quality Assessment

Two authors (MM, TS) independently assessed the quality of each included study using a modified Downs and Black (25) (Appendix 3). Any disagreement between reviewers in respect of study eligibility, data extraction or critical appraisal was firstly discussed between the two reviewers (MM, TS). If a consensus could not be reached a third reviewer (MT) acted as adjudicator.

Data Analysis

The study heterogeneity of the included studies was assessed by the two reviewers (MM, TS) through examination of the data extraction table. This demonstrated significant heterogeneity in respect of subject characteristics (definition of neck pain), co-interventions, environmental exposure (i.e. work-place/social circumstance) as well as the method of assessing PA participation. Based on these factors, it was inappropriate to conduct a meta-analysis of the data to identify factors associated with PA in subjects with chronic neck pain. A narrative analysis approach was therefore adopted to answer this question.

**RESULTS**

Search Strategy

A total of 7 studies met the selection criteria (Figure 1). However, one study was excluded (26) as on contacting the corresponding authors, they were unable to provide the cervical spine sub-group data from their whole spine data set. One study was excluded as the authors did not respond to our request for cervical spine data (27). A further study was excluded (28) as the data utilised was in a poster presentation format and then the same data was subsequently published in a peer reviewed journal (29). Accordingly, four papers were included in the final review (Cheung, Kajaks et al. 2013; Demirbuken, Ozgul et al. 2015; Hallman, Ekman et al. 2014; Rasmussen-Barr, Bohman et al. 2013).

Study Characteristics

The characteristics of the included studies are presented in Table 1. All four papers were cohort studies. Of these two were non-matched cohort studies (20, 29), whilst two studies (30, 31) were age and gender-matched cohort studies. One study also attempted to closely match the type of occupation (31). All studies sampled from the general population. A total of 1,925 subjects were sampled across the four studies.

Risk of Bias

Two reviewers (MM, TS) utilised a modified Downs and Black tool to appraise the quality of the articles (Supplementary table 2). Item 8 was removed from assessment as our review question and included studies did not assess the adverse effects of an intervention. Item 14 was removed as the research question of the included studies did not require that the subjects were blinded to the intervention. Items 17 and 21 were removed from the quality assessment of two of the studies as the study designs did not need to adjust for length of follow ups or take into account sampling from different populations (20, 29). Item 19 was removed from the assessment of all included studies as compliance was not an objective of their research. Items 23 and 24 were removed from assessment of all studies as randomisation was not indicated in the study designs.

The scoring between the two reviewers of the included studies had an agreement rate of 74% (95/128). Disagreements were around items 5-7, 11-12, 15-18 and 21-22. All disagreements were resolved during discussion and consensus was achieved. The mean risk of bias score over the four included studies was 59% with a range of 53-65%.

Physical Activity Measurement

Cheung (30) measured self-reported PA participation with a Rapid Assessment of Physical Activity (RAPA) tool and an accelerometry total activity count objective measurement tool. Demirbuken (29) used the International Physical Activity Questionnaire (IPAQ) tool. An accelerometry objective measurement device was used by Hallman (31). Rasmussen-Barr (20) utilised The Physical Activity Level (PAL) assessment tool.

Evidence of Physical Activity Participation Factors

A total of 6 factors were assessed against PA pursuits for subjects with neck pain. Of these, 2 factors demonstrated a statistical relationship whilst 4 did not. These factors are outlined below.

Pain

Cheung (30) and Demirbuken (29) assessed the relationship between pain and PA. Cheung (30) found a relationship between increased pain measured by pressure pain thresholds at the C2 paraspinal muscle and tibalis anterior sites and decreased PA measured by accelerometry (p=0.04). Increased pain pressure threshold at the C2 paraspinal site and decreased PA using RAPA assessment was significant in the neck pain group (p=0.03) only. In addition, there was a negative association between pain tolerance at the C2 paraspinal muscle site and RAPA assessment and between accelerometry and upper trapezius sites (p=0.05 and 0.02 respectively). Demirbuken (29) however, found no relationship between neck pain intensity and PA participation (p=0.432)

Fear of Movement

Demirbuken (29) was the only study to assess fear of movement (kinesiophobia) and PA participation. The study concluded that kinesiophobia was not a statistically significant factor in PA participation (Pearson Correlation, p=0.148, r= - 0.153).

Smoking Habits

One study examined the relationship between smoking and PA participation in subjects with neck pain. Rasmussen-Barr (20) reported that there was a non-significant negative association in male smokers with neck pain and decreased PA.

Socioeconomic Status

Rasmussen-Barr (20) assessed the relationship between socioeconomic status and PA participation in people with neck pain. The authors reported a non-significant negative association in males with neck pain who were of ‘lower’ socioeconomic class and PA.

Gender

The relationship between gender and PA participation was assessed by Demirbuken (29) who were unable to identify any significant relationship between gender and PA participation (Pearson Correlation p=0.07, r= - 0.043).

Leisure Time and Work Time

One study assessed the relationship between leisure time and work time habits in relation to PA participation. Hallman (31) demonstrated a statistically significant negative association between neck pain and leisure time PA measured by accelerometry (ANOVA Testing, p=<0.05). During working time there was a statistically significant negative association between neck pain subjects and PA measured by steps taken (ANOVA Testing, p=0.009), walking time (ANOVA Testing, p=0.026) but not in time spent lying or sitting (ANOVA Testing, p=0.069). Rasmussen-Barr (20) suggested that females with neck pain who perceived that they had increased physical workloads, took sick leave and spent more time at a computer at work had a non-significant negative association with PA participation.

In summary, our review identified conflicting evidence between factors associated with PA participation and neck pain based on a small number of heterogeneous studies. This will be discussed in more detail in the next section.

**DISCUSSION**

This is the first systematic review undertaken to investigate possible factors related to PA participation in adults with chronic cervical spine pain. From the four studies that met the selection criteria, six factors were identified: Pain, fear of movement, smoking habits, socioeconomic status, gender and leisure and work time. Based on moderate quality evidence, there was a statistically significant negative relationship between subjects with neck pain and decreased PA participation. Furthermore, subjects with neck pain were less likely to participate in PA in work and leisure time, which was also based on moderate quality evidence. All four studies utilised different objective methods of assessing PA levels.

Stubbs (18) systematic review investigated PA participation factors in subjects with knee osteoarthritis (OA) and found a negative relationship between increasing age, female gender, non-white ethnicity severity of symptoms and physical activity participation. These findings were similar to the findings in this review, identifying lowered pain thresholds and lowered pain tolerance in chronic cervical spine pain subjects as significant negative factors relating to PA participation. These studies suggest that reducing subjects’ pain is an important primary aim of treatment of chronic musculoskeletal conditions in order to help maintain physical functioning and activities of daily living. Interestingly, our review was not able to identify any studies demonstrating factors reporting a positive association with physical activity participation, whereas Stubbs (18) suggested lower limb function, balance and social participation are positive factors in PA participation in joint specific and mixed lower limb OA.

Relating PA participation factors in chronic cervical spine patient populations to other populations with chronic musculoskeletal spinal pain are challenging due to the dearth of evidence in this area. Hendrick (32) review suggested that PA levels in subjects with non-specific low back pain are neither associated nor predictive of pain levels and disability. Conversely, another systematic review suggested a moderate correlation between PA levels and disability in chronic low back pain (33). These differences may be attributed to differing inclusion criteria of each review, Lin (34) examined the relationship between PA levels and low back pain including studies using any validated measures of disability and PA objective measurements, whereas Hendrick (33) examined the outcomes, recovery and reoccurrence rates of low back pain in relation to PA levels. Moreover, Hendrick (33) only included longitudinal studies if there was already statistically significant relationship between PA participation and a low back pain outcome measure. Furthermore, both studies did not explore the factors associated with PA participation in low back pain populations.

Due to the limited evidence-base, further research is warranted to identify factors that are associated in PA participation in chronic cervical spine populations. Conducting more research in primary, secondary and tertiary healthcare settings and across varied ethnic and socioeconomic groups may provide greater insight into the factors associated with participation in PA. This review has focused on quantitative research investigating factors affecting PA participation. Future qualitative studies are warranted to investigate the underlying contextual factors from a first person perspective of why PA participation is undertaken, or not, in subjects with chronic cervical spine pain. Furthermore, qualitative investigations may help inform future prospective study designs. In addition, validating objective measurements of PA in chronic cervical spine population will be essential for consistency in future study designs.

Chronic pain is a complex biopsychosocial phenomenon that is challenging to assess and treat. Pain was identified as a significant negative factor in PA participation in cervical spine pain subjects. A future research priority will be to explore the prognosis, outcomes, recovery and reoccurrence rates of subjects with cervical spine pain and how this relates to PA participation. Furthermore, emerging work in pain sciences on the classification and phenotyping of underlying pain mechanisms in musculoskeletal pain may aid in refining the diagnosis of chronic cervical spine pain and direct more optimal treatment strategies. The relationship of PA participation to pain mechanisms-based diagnostic classification will need to be further explored in future research to assist optimal treatment strategies.

It is recognised that there are a number of potential limitations to our review. Firstly, only four highly heterogeneous studies were included. Therefore, the strength of our narrative analysis and how generalisable our findings are to clinical practice is open to question. We did identify two further studies that could have been included for review but unfortunately no response was received from one author and the other author was unable to provide the cervical spine data from their whole spine dataset. We acknowledge that a negative association between the factors identified and physical activity participation cannot, of itself, assume causation. In addition, three of the studies included had a total sample size of less than 50, which may mean their results being underpowered. As further research is undertaken, it is hope that we will be able to better understand potential factors to PA engagement for this population when we update the review. Lastly, each included study had different methods of assessing PA participation. Although these were all validated measures of PA including accelerometry, these tools have not been evaluated in chronic cervical spine population and the adoption of validated outcomes universally used within the literature will facilitate future meta-analyses.

**Conclusions**

Our review reports that that there is a negative association between pain, work and leisure time and decreased participation in PA in adults with chronic cervical spine pain. However, our conclusions should be viewed with caution as the current evidence-base is limited in size and quality. Further prospective studies in primary, secondary and tertiary healthcare settings are required to develop understanding of why patients may or may not participate in PA with this disabling musculoskeletal condition.

**Ethical Approval:**

None required

**Funding:**

None

**Conflict of Interest:**

There are no conflicts of interest

Figure 1. Study Selection - Flow Diagram

## Screening

## Eligibility

## Included

Records excluded

(n = 1, 556)

Records screened

(n = 1, 225)

Records after duplicates removed

(n = 2, 781)

## Identification

Records identified through database searching

(n = 2, 512)

Additional records identified through other sources

(n = 269)

Full-text articles excluded

(n = 35)

Reasons for exclusion:

* 8 articles paediatric population sample
* 7 articles not cervical spine
* 2 articles not physical activity
* 18 articles not measuring physical activity adherence

Reference checking

(n = 0)

Full-text articles assessed for eligibility

(n = 42)

Articles excluded on further review

(n = 3)

Articles included in quantitative synthesis

(n = 4)

Table 1- Study Characteristics

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Study** | **Design** | **Sample Size** | **Study Demographics** | **Cervical Pathology / Clinical Impression** | **Gender**  **(Male %: Female %)** | **PA measure** |
| Cheung 2013 | Matched-cohort (age and gender) | 40 (19/21) | Neck pain: 14 female-5 male; mean age 28 years. Pain intensity score 3.55; disability score; 13.6 (NDI). Duration >3 months.  Control: 17 female-14 male; mean age 23.7 years. Pain intensity score 0.05; disability score; 1.3 (NDI). | Chronic or recurrent neck pain for greater 3 months and greater pain intensity 2/10. No data on specific cervical spine pathology. | Neck pain: 14 female-5 male  Control: 17 female-14 male | (B) Self-reported physical activity with Rapid Assessment of Physical Activity (RAPA) tool.  (C) Accelerometry: total activity count, physical activity intensity. |
| Demirbuken 2015 | Cohort | 99 | Mean age: 43.6; BMI: 27.4; pain intensity: 6.47; kinesiophobia: 41.8; IPAQ: 3749.2. Duration of pain not documented. | Chronic neck pain (pain for 6 months or longer) | 34 males; 65 females | (B) International Physical Activity Questionnaire (IPAQ) |
| Hallman 2014 | Matched-cohort (age and gender; closely matched for type of work and production) | 56 | Neck-shoulder pain cohort: n=29; mean age 41; BMI: 24.6; duration of pain: 10 years; Control healthy cohort: n=27; mean age 41; BMI: 23.9; duration of pain: 0 years; | Chronic neck and shoulder pain (>6 months). Pain primary neck and/or trapezius muscle. | Neck-shoulder pain cohort: 13 women; 16 males; Healthy cohort: 12 females; 15 males | (C) Accelerometry worn over a 7 day period |
| Rasmussen – Barr 2013 | Cohort | 1730 | 495 males; 1235 females; characteristics of age but ranged from 18-65, BMI and other characteristics are not presented as a cohort. Duration of symptoms not explicitly stated. | Persistent neck pain defined as pain daily during the past 6 months. | 495 males; 1235 females | (B) PAL – Physical Activity Level Assessment |

*(Notes: PA Measurement*

*A: Self-report with unknown/not reported reliability/validity in cervical spine pathology*

*B: Self-report with acceptable reliability/validity in cervical spine pathology (if known/any)*

*C: Objective measurements)*

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