TITLE PAGE

Title:

Physical Activity Participation and The Association With Work Related Upper Quadrant Disorders (WRUQDs). A Systematic Review

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ABSTRACT

Background:

Workers of various occupations often report Work Related Upper Quadrant Disorders (WRUQDs). Research has shown that associative factors for WRUQDs include psychosocial and environmental elements, gender and physical activity levels. To date no review has investigated whether physical activity participation is associated to the incidence or may predict the development of WRUQDs.

Objective:

To determine whether physical activity participation is associated with and/or predicts the development of Work Related Upper Quadrant Disorders (WRUQDs)

Methods:

A systematic review was conducted including searches of PubMed (MEDLINE), EMBASE and CINAHL from inception to March 31st 2017. Quantitative studies including any outcome measure of physical activity participation and its association with and/or prediction to WRUQDs were included. One reviewer conducted the search and two reviewers independently assessed eligibility and completed methodological quality assessment using a modified Downs and Black checklist. Data was analysed narratively.

Results:

Eight studies were eligible for inclusion in the final review. The quality of these ranged from moderate to high quality. Three studies reported nil statistical difference between physical activity participation and the risk of developing WRUQD. Three studies reported a negative and one study reported a positive association between physical activity participation and WRUQDs. One study reported that little or no physical exercise participation was a risk factor WRUQD.

Conclusion:

There is limited evidence for a negative association between physical activity participation and WRUQDs development. However this was not a consistent finding across all studies included. Further research is indicated in standardising diagnostic criteria and physical activity participation measurement in this patient population.

Key Words: Physical Activity; Work Related Upper Quadrant Disorders

PROSPERO REGISTRATION NUMBER: CRD42016047776

MANUSCRIPT (TEXT)

INTRODUCTION

Work-related musculoskeletal disorders are a common cause of work place absenteeism (Health and Safety Executive, 2016). There were 176,000 new cases of work-related musculoskeletal disorders reported in 2015/16 with an estimated incidence of 550 cases per 100,000 people (Health and Safety Executive, 2016). The United Kingdom (UK) had an estimated loss of 8.8 million working days due to work-related musculoskeletal disorders in 2015/16. This accounts for 41% of all work-related illness absence (Health and Safety Executive, 2016). Absence relating to work-related musculoskeletal disorders can result in a loss of productivity and have associated health care costs for employees, employers and healthcare providers (Bhattacharya, 2014; Downey, 2013).

Work-Related Musculoskeletal Upper Quadrant Disorders (WRUQDs) represent a sub-group of work related musculoskeletal disorders. WRUQDs are defined by The National Institute for Occupational Safety and Health (NIOSH) as: (a) symptoms of pain, aching, stiffness, burning, tingling, and/or numbness in the fingers, hands, wrists, elbows, arms, shoulders, or neck regions; *and* (b) symptoms beginning after employment at the present job; *and* (c) symptoms having lasted for more than one week, or at least once per month since their onset; *and* (d) no prior non-occupational accident or acute trauma to the symptom area within the past year; *and* (e) no prior diagnosis to the specified symptom area (*Musculoskeletal disorders and workplace factors*1997). WRUQD is the second most common cause of work-related musculoskeletal disorders, with only lower back pain being more common (Health and Safety Executive, 2016). In 2015/16 WRUQDs accounted for approximately 36% of days lost attributed to all work-related musculoskeletal disorders, which equated to a

mean of 14.1 work days lost per WRUQD case (Downey, 2013; Health and Safety Executive, 2016).

Work-related musculoskeletal disorders, including WRUQDs, develop in many occupational environments including office, agricultural and forestry, construction, transport and health and social care settings (J. T. da Costa, Baptista, & Vaz, 2015). There are multiple factors that are implicated in the development of work-related musculoskeletal disorders and are likely to interact with one another. Examples include, personal factors such as age and sex (Bernal, 2015; J L Brozek et al., 2008); psychosocial factors such as social support and job control (Bernal, 2015) and physical factors such as sustained postures, sedentary behaviours and repetitive manual or vibration tasks (Widanarko, 2014).

Systematic reviews investigating the risk factors for the development of WRUQDs have reported that work scheduling and physical demands such as repetitive manual handling and awkward postures can be associated with nursing and midwifery professions (Long, Johnson, & Bogassian, 2012). Whereas heavy physical work, smoking, high body index and the presence of other co-morbidities are reported to have an association with all work-related musculoskeletal disorders in office, forestry and construction occupational settings (B. R. da Costa & Vieira, 2010).

Physical activity is defined as any bodily movement that requires energy expenditure. Physical activity may be sub-grouped into three categories including active transport (for example, walking the stairs instead of elevators), active living (for example, vacuuming) and sports and exercise (Public Health England, 2014; World Health Organisation, 2010). Physical inactivity has been strongly associated with the development and exacerbation of chronic health problems, including diabetes mellitus,

ischemic heart disease, cancer (Lee et al., 2012) and musculoskeletal complaints such as neck pain (Hallman, Ekman, & Lyskov, 2014), low back pain (Orr, George, & Simon, 2016) and lower limb osteoarthritis (Stubbs, Hurley, & Smith, 2015). To date no review has been published synthesising the possible association of physical (in)activity in the development of WRUQDs across multiple occupational settings. Furthermore, no review has been conducted to investigate whether the incidence of WRUQDs is associated to physical activity participation. Gaining insight into this possible association between the development and incidence of WRUQDs will enhance assessment and management strategies for individuals, employers and health care professionals.

Accordingly, the primary aims of this review are to investigate the incidence of WRUQDs in association to physical activity participation and whether physical (in)activity may predict the development of WRUQDs.

METHODS

The systematic review was registered with PROSPERO review database (Ref: CRD42016047776), and completed following the PRISMA guidelines of reporting (Moher et al., 2009).

Search Strategy

One reviewer (MM) conducted the systematic search of electronic databases PubMed (MEDLINE), EMBASE and CINAHL from inception to March 31st 2017. Figure 1 reports an example of the search strategy used in MEDLINE. An unpublished (grey) literature

search and trial registry search was also completed. 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.

Figure 1 – MEDLINE search strategy. Completed on 2nd October 2016

Work: Employment OR Job OR Work* OR Occupation*

AND

Musculoskeletal: MSK OR Musculo* OR Injur* OR Repetitive strain OR Repetitive sprain OR Overuse syndrome OR Musculoskeletal disease OR musculoskeletal disorder OR Muscle OR Joint OR Soft tissue OR Pain

AND

Upper Quadrant: Upper limb OR Upper quadrant OR Upper extremity OR Neck OR Cervical spine OR Shoulder OR Upper back OR Elbow OR Wrist OR Hand OR Thoracic OR Fingers OR Digits OR Arm

AND

Physical Activity: Physical activity OR Physical inactivity OR Exercise OR Sedentary

Eligibility Criteria

Studies were included if they met the following criteria:

a) Any observational study type
b) The dependent variable being physical activity participation
c) Adult participants (over 18 years) with a diagnosis of WRUQD using a modified version of the National Institute for Occupational Safety and Health (NIOSH) case definition criteria of WRUQDs (i-v) detailed below

(i) Symptoms of pain, aching, stiffness, burning, tingling, and/or numbness in the fingers, hands, wrists, elbows, arms, shoulders, or neck regions; and

(ii) Symptoms beginning after employment at the present job; and

(iii) Symptoms having lasted for more than one week, or at least once per month since their onset; and

(iv) No prior non-occupational accident or acute trauma to the symptom area within the past year; and

(v) No prior diagnosis to the specified symptom area

It was anticipated that some studies may not report factors (iv) and (v), therefore an analysis of eligible studies was undertaken to determine whether factors (iv) and (v) have been included. If factors (iv) and (v) were not explicitly reported by authors, an additional sub-analysis was undertaken to include these studies without these factors.

Any outcome measure capturing physical activity during work or leisure time 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 physical activity was not measured or if the participants' WRUQD were related to systemic pathology, fracture, myelopathy or upper motor neurone pathology.

Study Identification

Based on 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. An assessment of reliability (between-reviewer) for the eligibility criteria was performed for a random sample of 10 potentially eligible papers using a weighted Kappa statistic. This indicated that the between-reviewer agreement ranged from 0.11 to 1.00 across the criteria, with perfect (Kappa: 1.00) for overall agreement on eligibility of individual papers (available on request)

Data Extraction

Data were extracted onto a pre-defined data extraction table independently by one reviewer (MM) and verified by a second reviewer (TS). Data extracted included: study characteristics, study type (setting and design), subjects (number, age and gender), work environment and details of WRUQD 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 (Downs & Black, 1998). 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.

Two reviewers utilised a modified Downs and Black tool to appraise the quality of the articles. 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. Item 15 was removed as the research question of the included studies did not require blinding of assessors to an intervention. 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 88% (147/168). Disagreements were around items 20-22 and 25-27 which were all resolved through discussion and consensus was achieved.

Data Analysis

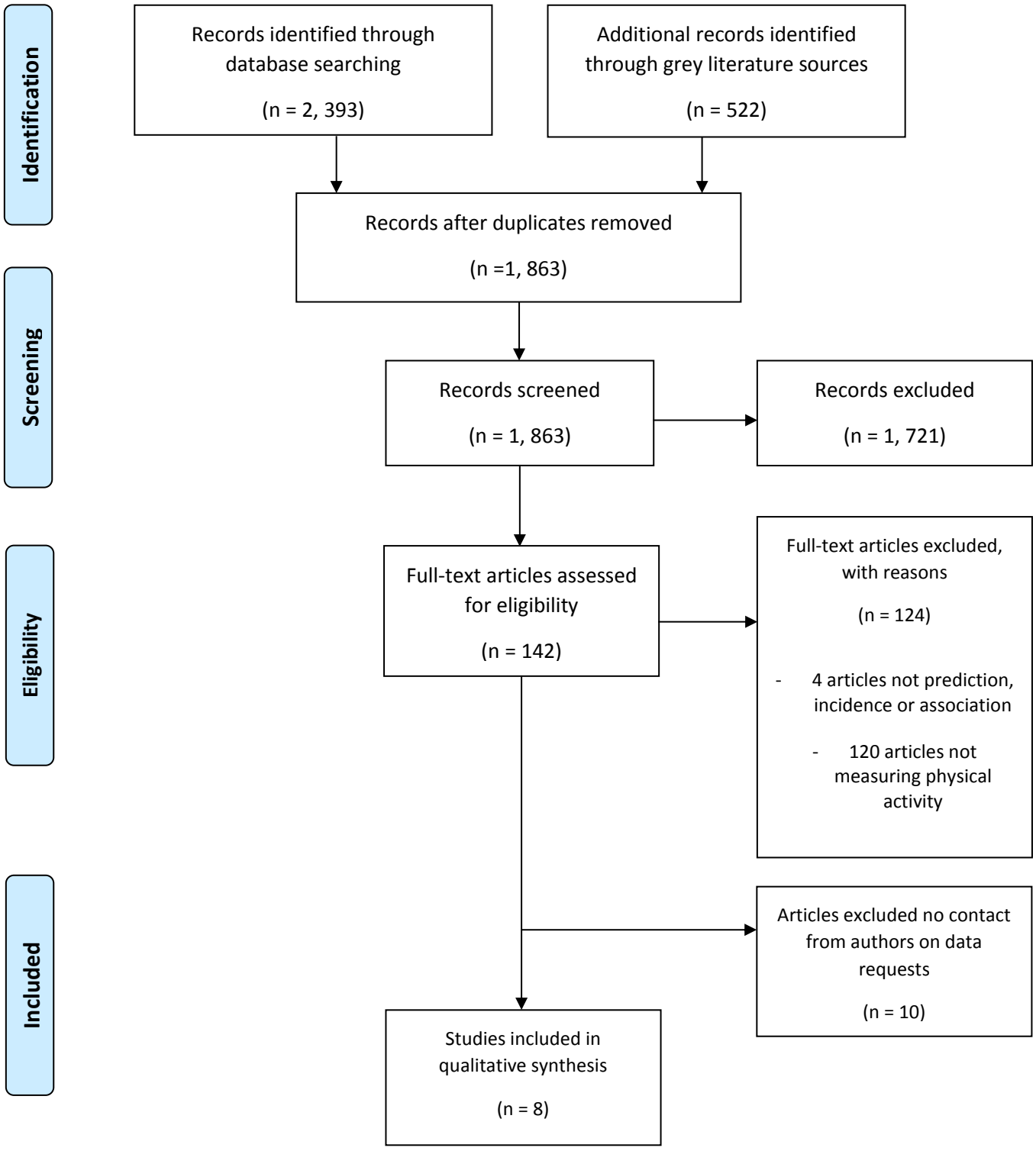
The study heterogeneity of the included studies was assessed by the two reviewers (MM, TS) through examination of the data extraction table. This demonstrated significant heterogeneity in respect of subject characteristics (definition of WRUQDs), co-interventions and the method of assessing physical activity and it was therefore inappropriate to conduct a meta-analysis. As a result a narrative analysis approach was completed to answer our question.

RESULTS

Search Strategy

Eighteen studies met the selection criteria (Figure 2). However 10 studies were excluded as the authors failed to respond to our request for upper quadrant data (Batham & Yasobant, 2016; Feveile et al., 2002; Haukka et al., 2015; Howard et al., 2013; Hush et al., 2006; Kumar et al., 2004; Memarpour et al., 2013; Nag et al., 2012; Sihawong et al., 2014; Sogaard et al., 2009). Eight studies were therefore included in the final review (Al-Mohrej et al., 2016; Feng et al., 2014; Gelfman et al., 2010; Hagberg et al., 2007; Hesselman et al., 2016; Park et al., 2010; Slot & Dumas, 2010; Yue et al., 2012).

Figure 2. Study Selection - Flow Diagram



Study Characteristics

The characteristics of the included studies are presented in Table 1. Six studies were cross-sectional surveys or questionnaires (Al-Mohrej et al. (2016), Feng et al. (2014), Gelfman et al. (2010), Park et al. (2010), Slot et al. (2010) and Yue et al. (2012)). The other two studies were cohort study designs, one was non-matched (Hagberg et al. 2007) and one was gender-matched (Hesselmann et al 2009).

Table 1 – Study Characteristics

Study	Design	Sample Size	Study Demographics: Age; Sex; Duration of Symptoms	WRUQDs Diagnosis Classification	Occupation / Work Environment	Physical Activity Measurement	Prediction / Risk Factor	Association With Physical Activity
Al-Mohrej (2016)	Cross Sectional Survey	204	38.0 ± 10.6 Years 49% female, 50.5% male. 88% <4 weeks, 9.1% 2-3months, 2.3% >6 months.	Standardised Nordic Questionnaire (Kuorinka et al. 1987).	Restorative dentistry, Periodontics/prosthodontics, Paediatrics/orthodontics, Endodontics and GP/maxillofacial dentistry	Self Measurement “Yes / No”	Neck – OR 1.412 (0.740 to 2.695) Shoulder – OR 2.383 (1.185 to 4.791) Hand / Wrist – OR 2.000 (0.897 to 4.457).	**Negative Association.** No exercise = Greater Chance of Work Related Upper Quadrant Disorder.

Feng (2014)	Cross Sectional Survey	272	34.7±8.9 years (range: 20–60). Males (n=151) Females (n=121).	Standardised Nordic Questionnaire (Kuorinka et al. 1987).	Dentists (Guangzhou, China)	Question: "How many times do you exercise every week?"	Neck – OR= 0.37 (0.14 to 1.00)	**Negative Association.** No exercise = Greater Chance of Neck Pain.
Gelfman (2010)	Cross Sectional survey	314	98.7% Female Nil Age Nil Duration of symptoms detailed	DASH (Upper limb, shoulder & arm) (Hudak, Amadio & Bombardier, 1996)	Medical transcriptionists, Large healthcare facility in the Midwestern USA	Self-assessment question: "How often do you exercise *Never to Rare, Occasionally* or *Regular*"	Nil data	**Negative Association.** *(Never-Rare* vs O*ccasional-Regular* had a higher DASH score)

Hagberg (2007)	Cohort study design	1039	590 Female, 449 Men Nil age data Nil duration data	Bespoke self-reporting assessment on subjects reporting reduced productivity or sick leave owing to symptoms of at least 3 days duration	Swedish occupational health centres	Self reported frequency over 1 month period *A lot* (8 times, 30 min last month) *Medium* (1–7 times, 30 min last month) *Not at all*	*Medium:* Neck - HR= 1.9(1.05–3.62). Shoulder - HR= 3.1(1.11–8.64). Forearm / Hand HR= 3.3(1.36–8.01).	**Negative Association**. Little or no physical exercise was a risk factor for self-reported reduced productivity

Hesselman (2009)	Cohort study design	429	224 Male, 205 Female 34 years and 52 years of age (Two sampling stages) 17% Males & 22% Females had neck or shoulder pain, ache or discomfort any time during the last 7 days	Nordic Musculoskeletal Questionnaire (Kuorinka et al. 1987): “Have you at any time during the last 7 days had trouble (ache, pain, or discomfort) in your neck?” and “Have you at any time during the last 7 days had trouble (ache, pain, or	Nil data	MET (MET-hours per week)	OR at 34 years= 1.06 (1.00–1.12); OR at 52 years= 1.00 (0.98–1.02)	**No significant differences** in METs between groups who reported pain and those who did not

				discomfort) in your shoulders?"				
Park (2010)	Cross-sectional questionnaire	2140	43.3 years (SD 24.5 years). All male	Subjective symptoms of WRUEMSD were composed of four body parts: the hand, wrist, and fingers; arm and elbow; shoulder; and neck.	Production fish yard workers. South Korea	Question: "Do you exercise? Y/N answer"	Nil statistical difference between exercisers and non-exercisers	**Nil significant difference**

				WRUQD was defined according to criteria developed by one of the authors. Specifically, the score was calculated based on duration, frequency, and severity of the symptoms multiplied by the symptom score				

Slot (2010)	Cross-sectional survey	14	21.0 SD 1.47Years. 7 male, 7 female	Musculoskeletal Symptoms Questionnaire (Corlett & Bishop, 1976).	Tree planters. Canada	International Physical Activity Questionnaire (Booth, 2000). MET-minutes/week	Nil link between exposure and WRUQDs	**Nil significant difference**
Yue (2012)	Cross-sectional survey	893	32.21 ± 10.61 Years 67% women	Nordic Musculoskeletal Questionnaire (NMQ) (Kuorinka et al. 1987). Neck/shoulder pain lasting 1 day during last 12 months	School teachers, multi schools across large eastern city China	Self-reported hours of physical exercise per week	Physical exercise per week (h) ⩾7 h - OR=0.55 (0.35-0.86)	**Positive association**. The more physical activity participation the less likely neck/shoulder pain

A total of 5,305 subjects were recruited across the eight studies. Four studies recruited participants from healthcare centres or hospitals (Al-Mohrej et al. 2016, Feng et al. 2014, Gelfman et al. 2010 and Hagberg et al. 2007). Park et al (2010) recruited from fishyard in South Korea, Slot et al (2010) recruited tree surgeons and Yue et al (2012) recruited participants from multiple inner-city schools. One study did not provide information on where their subjects were recruited from (Hesselmann et al 2009).

Quality Assessment

The quality assessment using a modified Downs and Black assessment tool varied considerably across the eight included studies. The three most frequent criteria satisfied on the quality assessment were criteria 1, *Is the hypothesis/aim/objective of the study clearly described;* criteria 2 *Are the main outcomes to be measured clearly described in the Introduction or Methods section?* and criteria 6 *Are the main findings of the study clearly described?* The three most frequent criteria that were least satisfied were criteria 25, *Was there adequate adjustment for confounding in the analyses from which the main findings were drawn?;* criteria 26, *Were losses of patients to follow-up taken into account* and criteria 27 *Did the study have sufficient power to detect a clinically important effect where the probability value for a difference being due to chance <5%.* The mean risk of bias over the eight studies was 67% with a range of 43-76%.

Measurement Methods for Physical Activity

Two studies (Al-Mohrej et al., 2016; Park et al., 2010) measured self-reported physical activity participation with a question of whether participants participated in physical activity with a *yes or no* answer. Yue (2012) and Feng et al (2014) measured self-

reported physical activity participation asking how often a week the participants participated in exercise. Gelfman (2010) utilised a self-assessment question of "*How often do you exercise - Never to Rare, Occasionally or Regular*". Hagberg (2010) measured physical activity participation through a self-reported frequency over a one month period. Hesselmann (2009) measured physical activity participation through participants' metabolic equivalent of task (MET) hours a week. Slot (2010) also utilised MET hours a week and incorporated the International Physical Activity Questionnaire (IPAQ) (Booth, 2000).

Analysis 1: Physical Activity Participation and Association to WRUQDs

Of the eight studies included, three studies reported no statistical difference between physical activity participation and the risk of developing WRUQD. Hesselmann (2009) reported no significant differences in METs between participants who reported WRUQDs and those who did not (Odds Ratio (OR) 1.00; 95% confidence intervals (CI): 0.98 to 1.02). Slot (2010) who also measured MET, reported no association between physical activity levels and WRUQDs (No data available in study or on author contact attempts). The relationship between self-reported exercise participation through "*yes or no*" questioning reported nil statistical differences between exercisers or non-exercisers; hand/wrist (OR 0.80; 95% CI: 0.62 to 1.02), arm/elbow (OR 0.91; 95% CI: 0.72 to 1.15), shoulder (OR 0.93; 95% CI: 0.75 to 1.16) and neck (OR 0.87; 95% CI 0.68 to 1.11) (Park 2010).

Three studies reported a negative association between physical activity participation and WRUQDs where physical activity was lower in those who reported WRUQD. Al-Mohrej (2016) reported this in dental workers with work-related neck (OR 1.41; 95% CI:

0.74 to 2.70), shoulder (OR 2.38; 95% CI: 1.19 to 4.79) and hand (OR 2.00; 95% CI: 0.90 to 4.46) symptoms. Feng (2014) reported a statistical significant relationship between dentists who did not participate in physical activity and work-related neck symptoms (OR 0.37; 95% CI: 0.14 to 1.00). Gelfman (2010) reported a negative association (but no data were presented) between higher Disabilities of the Arm, Shoulder and Hand (DASH) (Hudak, Amadio & Bombardier 1996) scores with participants who *rarely* or *occasionally* participated in physical activity. One study reported that little or no physical exercise participation was a risk factor for self-reported productivity reduction and work-related neck symptoms (Hazard Ratio (HR): 1.9; 95% CI: 1.05 to 3.62), shoulder symptoms (HR 3.1; 95% CI: 1.11 to 8.64) and forearm and hand symptoms (HR: 3.3; 1.36 to 8.01)

One study reported a positive association between physical activity participation and WRUQDs. Yue (2012) reported that school teachers who participated in ≥7 hours of physical exercise per week were less likely to develop WRUQDs (OR 0.55; 95% CI: 0.35 to 0.86).

Analysis 2: Sub Group Analysis of National Institute for Occupational Safety and Health (NIOSH) WRUQDS Case Definition Criteria

All eight studies included did not explicitly report criteria (iv) no prior non-occupational accident or acute trauma to the symptom area within the past year; and (v) no prior diagnosis to the specified symptom area. Therefore, the planned sub-group analysis was not performed.

DISCUSSION

This is the first systematic review investigating the incidence of WRUQDs in association to physical activity participation and whether physical (in)activity may predict the development of WRUQDs. From the eight included studies, three moderate quality studies reported no statistical difference between physical activity participation and the risk of developing WRUQD. Three moderate to high quality studies reported a negative association between physical activity participation and WRUQDs. One moderate quality study reported a positive association between physical activity participation where physical activity was lower in those participants reporting WRUQD. One moderate quality study reported that little or no physical exercise participation was a risk factor for self-reported productivity reduction and work-related neck, shoulder, forearm and hand symptoms. All eight studies used varying self-reported and objective measurements of physical activity participation.

The current evidence presented with a wide variance of the working environments and occupations of the recruited participants. Four studies recruited healthcare workers from healthcare centres or hospitals in China, Sweden or USA. One study recruited fishyard workers in South Korea and one study recruited teachers in an inner city in China. This may impact the external validity to other occupations and working locations. Furthermore, the classification of WRUQDs varied between each study, including objective measurements such as the Nordic Musculoskeletal Questionnaire, DASH and self-reported bespoke questionnaires. This variance in outcome measures has not, to the authors' knowledge, been tested in the subjects diagnosed with WRUQDs which may further question the reliability and external validity.

Sitthipornvorakul et al (2011) reported the association between daily physical activity and neck and low back pain. They concluded that there was limited evidence for no association between physical activity and neck pain in adult workers, which was based on one study included in for review (Sitthipornvorakul et al., 2011). Our review included three studies reporting a negative association between physical activity participation and WRUQDs (Al-Mohrej et al., 2016; Feng et al., 2014; Gelfman et al., 2010). This difference could be attributed to the difference between inclusion and exclusion criteria of the individual studies. Sitthipornvorakul et al's (2011) findings relate to the general population whereas the studies in our review only included a participant population with a diagnosis of WRUQDs, which encompasses neck pain.

Relating physical activity participation levels in the WRUQDs population to other populations with chronic musculoskeletal pain may provide further insight and understanding to assessment and management strategies. However, there are a limited number of studies published in this area of research. In adults with low back pain, there were conflicting results between the association of physical activity participation and low back pain in general population (Sitthipornvorakul et al., 2011). These findings, similar to our review, may be attributed to the heterogeneity in methods of exposure assessment among the included studies. Some studies utilised objective measurements such as pedometers and others used retrospective self-assessment exercise participation questionnaires. Furthermore, another systematic review examining the association between sedentary lifestyle and low back pain reported only one high quality study associating sedentary behaviour being a risk factor for developing low back pain (Chen et al., 2009). However, these findings may be attributed to the inclusion criteria of Chen et al (Chen et al., 2009), as the authors

included studies that only investigated the association between *sitting* and low back pain.

Following this systematic review, further research is warranted to identify the association of physical activity participation and prediction of WRUQDs. The consistency of WRUQDs definition and inclusion criteria needs to be established in future studies, this will enhance the analysis of results when this review is updated. The validation of physical activity participation measurements in people with WRUQDs should be considered to ensure greater consistency in future study designs. To further improve our understanding, a research priority is to undertake studies in other *skilled* and *non-skilled* professions across multiple working environments and healthcare settings. This would improve the generalisability of results.

Individual's barriers and facilitators for undertaking physical activity are multifactorial, with complex interactions (Stubbs et al., 2015). These may include pain severity and work and leisure time habits (Mansfield et al., 2017), social support and access to facilities (Stubbs et al., 2015). Future research should also aim to address why participants with WRUQDs may or may not participate in physical activity and how this relates to prognosis and outcome. This would provide a deeper understanding of possible assessment and management strategies to support high-quality healthcare management in this patient group.

There are a number of potential limitations to our review which is a results of the current available literature. Firstly, we identified 18 studies that met our inclusion criteria. Of these, 10 were excluded as the authors did not respond to our request on

WRUQDs. As a result, it remains unclear whether these papers, excluded due to limited reporting on WRUQD, may have affected the conclusions made from the review. Secondly, the occupation of recruited participants and their working location varied between manual workers, hospital workers (including dentists and administration staff) and inner city school teachers. This reduces the generalisability of the analysis to specific populations, making interpretation potentially more challenging. Finally, the measurement of physical activity participation in each study did vary, with limited use of accelerometry in WRUQDs populations. The use of more objective assessments of physical activity could therefore negate the potential risk of recall error and social desirability bias which may occur with patient reported measures of physical activity (Kowalski et al., 2012).

CONCLUSIONS

There is a limited evidence-base to indicate a negative association between physical activity participation and WRUQDs development. However this was not a consistent finding across all included studies. Further research is indicated in standardising diagnosis classification criteria and physical activity participation measurement in this patient population to further our understanding on how physical activity participation may or may not relate to the development of WRUQDs.

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Conflict of Interest:

There are no conflicts of interest

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