REVIEW ARTICLE

DOESTHE DEFINITION OF MULTISITE MUSCULOSKELETAL PAIN INFLUENCE ITS OCCURRENCE AND THE ASSESSEMENT OF PHYSICAL WORK EXPOSURES?

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ABSTRACT

Most people with musculoskeletal problem suffer pain at multiple body sites. The most frequent form of multisite pain studied is chronic widespread pain (CWP). Focusing solely on CWP may exclude the commoner form of multisite pain which is less wide spread. Therefore, studies on multisite pain which do not consider the spatial distribution of pain can be beneficial to tackle the overall problem of musculoskeletal pain. Nevertheless, multisite pain has been defined differently in the studies among workers. The absence of uniformed definition will jeopardize the understanding of this musculoskeletal problem. A review was thus carried out to identify how multisite pain were defined, how they influenced the reported occurrence of multisite pain and whether the definition determined the physical work exposures assessed in previous studies among worker. A systematic review was initiated by the search of electronic databases for multisite pain. Articles were included and excluded based on the selection criteria. A final of nine full text articles were reviewed. It was found that the difference in the definitions lies mainly in the body sites considered and the pain characteristics. The characteristics of pain influenced the multisite pain prevalence more than the sites.It wasdifficult to conclude whether the definition used determined the physical work exposures since only five studies were involved and three of them had similar research team which may explained the usage of similar exposures. The findings from this review, however, could not be inferred due to the small number of studies involved.

***Key words**: multisite pain, musculoskeletal pain, workers, prevalence, work risk factors*

INTRODUCTION

Previous researches were done to understand the occurrence of musculoskeletal pain in both the general and working population. Most of them studied musculoskeletal pain according to the specific sites or regions of the body. Nevertheless, it was found that single site pains rarely exist alone. They commonly co-exist with musculoskeletal pain at other sites of the body. About three-quarter of the general population who had musculoskeletal pain was found to have co-existing pain[1-2]. Therefore, the studies on the nature, risk factors and consequences of musculoskeletal pains that occur more than one site may greatly contribute to the prevention and intervention activities of musculoskeletal pain among both the general and working population.

Musculoskeletal pains that occur at multiple sites were commonly studied as chronic widespread pain (CWP). CWP is defined as musculoskeletal pain that occurred more than 3 months involving both left and right sides of the body, both above and below the waist and also the axial skeleton. Therefore, using CWP as the definition to musculoskeletal pain at multiple sites will limit the condition into a specific spatial distribution of pain. Furthermore, CWP has been postulated to be the end spectrum of musculoskeletal pain continuum and it relates more to a severe disease which is characterized by cognitive problems such as fatigue, sleep disturbances and depression[3-5]. Therefore, it may not be the best condition to be studied if the ultimate aim is to have early prevention of musculoskeletal disorders among workers. In addition, even though CWP reflects a more severe condition with poor impact to work productivity and life outcomes[6-8], its prevalence in the population was found to be much lower than the multiple sites pain without the CWP distribution[1,6]. Therefore, defining the condition of musculoskeletal pain at multiple sites as CWP will cause a large proportion of workers having multisite pain being ignored.

Musculoskeletal pains at multiple sites that are simply defined by the number of sites involved had been suggested as a better option in the research of musculoskeletal pain among workers[9].Musculoskeletal pain that occurs at more than one site and is defined only by its multiplicity of pain sites and not the spatial distribution is commonly termed as multisite pain. Nevertheless, multisite musculoskeletal pain has been defined in various ways by researchers. Uniformed definition is, however, known to be vital in epidemiological venture because it has major impacts on the occurrence of the disease and this may ultimately influence the determination of its risk factors. The problems of non-uniformed definition are well recognized in the field of musculoskeletal disorders[10].The non-uniformed multisite definition may also influence the physical risk factors assessed. In the studies of regional musculoskeletal pain, the physical work exposures that were

frequently assessed were based on the hazardous biomechanical exposures to the region. For example, the physical work exposures frequently assessed for wrist-handregion were extreme flexion or extension of the wrist, repetitive movements of the fingers and hands and forceful effort such as precision and pincer grip[11]. In multisite pain, since there are multiple sites or regions involvement, the determination of which physical exposures to be assessed is not that straight forward. One of the issues that need to be looked at include whether all the physical exposures related to each region involved in the multisite definition should be used. Currently, there has not been any review to see the actual physical work exposures considered in the previous multisite pain studies and whether they were determined by the definition of the multisite painused. Therefore, this review was done to determine the various definitions used for multisite pain in previous studies among workers and to identify how these definitions influenced theoccurrence of multisite pain. In addition, it would identify whether the anatomical sites considered in the definition of the multisite pain determined theselection of physical work factors assessed in those studies.

METHODOLOGY

Search strategy

Electronic databases of PubMed, Medline, Web of Science and Google Scholar were searched using keywordsmultisite pain, multiple sites pain, multiple regional pain and musculoskeletal pain (text word and MeSH subheading).Citations from the result of this search were screened and selected according to the selection criteria. Some of the papers were manually identified through the search of references of the included studies. All articles published until December 2014 were eligible for inclusion in this review.

Selection criteria

Studies were included in the review if the following conditions were met: (i) the paper was a full report published in English (ii)the study was done among workers (iii) the definition of multisite pain was presented. Studies that did not present the information on the occurrence of multisite pain and studies that included pain at other systems such as abdominal pain were excluded.

Data extraction and analysis

Details on the study populations, sample size, definition of multisite pain (sites and characteristic of pain considered) andoccurrence of multisite pain were extracted from each of the study. The information on the physical work exposures assessed in the studywas also extracted if available.

RESULTS

A total of 131 citations have been identified through the electronic database searches (Figure1). Eighteen of these were found to meet the inclusion criteria. After reviewing the 18 full articles, 12 articles were excluded based on the exclusion criteria. Identification of further 3 articles was made after screening of references in the relevant articles. A total of 9 articles were finally included and reviewed.

Six of the articles were cross-sectional studies[9,12-16] and only three articles had prospective cohort design[17-19].Regarding the quality of the studies, the response rates for all the cross-sectional studies were found to be high (≥80%)where as for the cohort studies, one study showed response rate of lower than 80% (61%) for participation in both baseline and follow-up (Table 1).

The definitions of multisite musculoskeletal pain

Review of the final full text articles showed various definitions were used to characterize the multisite pain. The difference in the definitions lies mainly in the body sitesconsidered and the characteristic of pain (Table 2 and Table 3). There were basically two classifications of sites considered in the definition of multisite pain. The first sites classification considered each of the anatomical or joint sites of the body[12-14,18]. However, the laterality of the sites was not considered except for one study[9].Also, there were some sites omitted in two of the studies where the sites ofthe lower limb were not considered except the knee[14,18]. Another classification had grouped the sites into regions. Four regions had been considered which are the wrist/elbow region, neck/shoulder region, low back region and lower limb region. One study considered the wrist/elbow region and neck/shoulder as aregion[16].

As for the characteristicof pain, three studies considered pain as plainly as the presence of pain[12-13,15]. A more detailed characteristic of pain had been utilized in the other studies which were the duration of pain or the impact of pain to everyday life. Four studies had used the durations of pain such as pain more or equal to one day, 30 days or 6 months[9,14,16,18]. The study that defined pain as more than 6 months also incorporated presence of positive clinical signs in the definition[19].Two studies had used the severity of pain to define the characteristic of pain which werethe degree of pain (no pain to very much pain) and the effects of the pain onthe pre-specified daily living activities (disabling pain)(Table 3)[14,17].

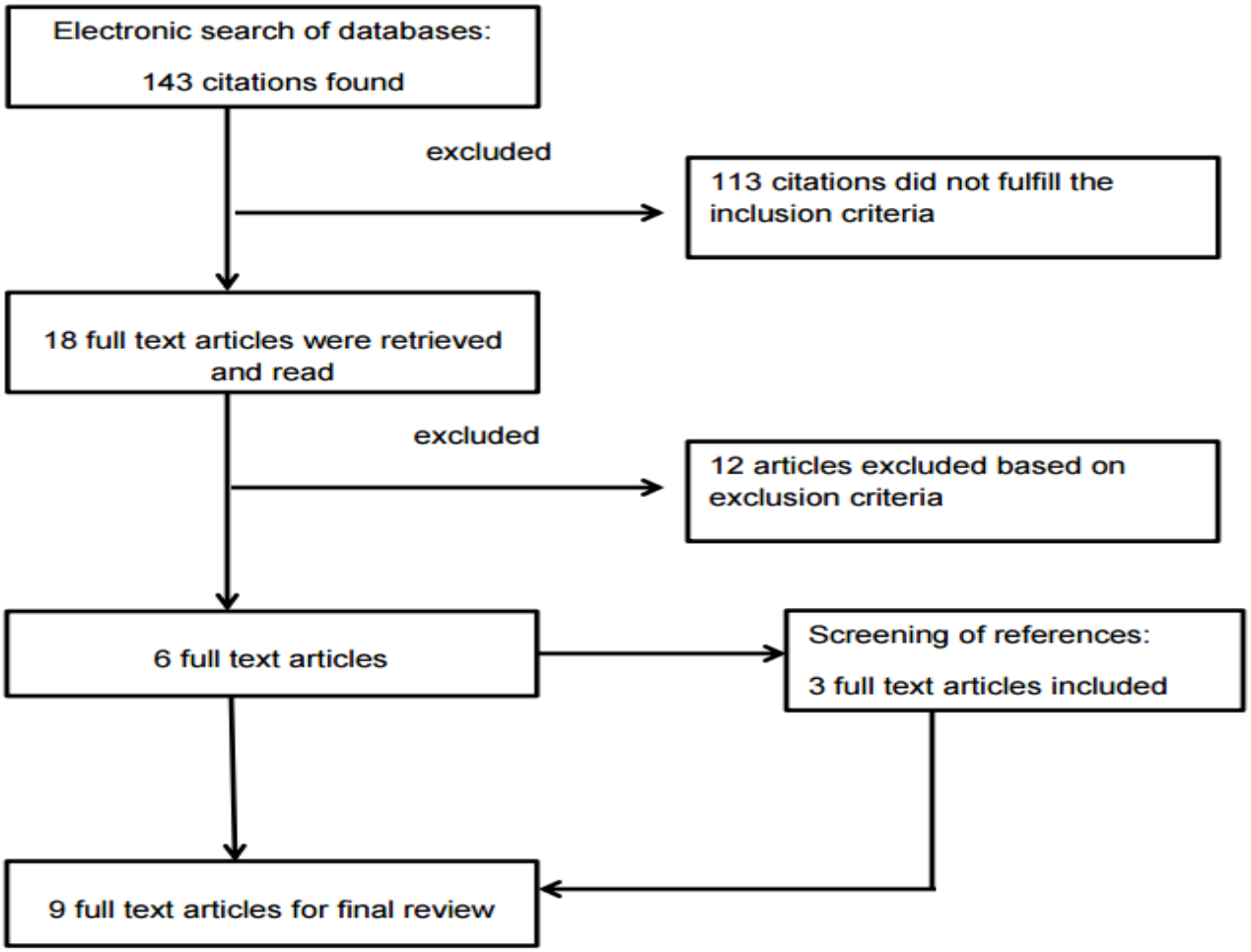

FIGURE 1: Flow and result of the systematic search

The occurrence of multisite musculoskeletal pain

The designs of previous studies on multisite pain among workers include cross-sectional and prospective cohort studies. Therefore, the prevalence and incidence of the multisite have been documented. Both one-year prevalence and period prevalence (1-month and 3-month) were considered in the cross-sectional studies (Table 2). For multisite pain that present or last at least more than a day, the 12-month prevalence ranged from 64% to 67%[12,14,16]. While the 12-month prevalence of multisite pain that occurred more than 30 days was found to be much lower where it ranged between 17% and 19%[14,16]. These prevalences seemed similar despite the differences in the definition of anatomical sites considered and the population studied.

For one-month prevalence of multisite pain with similar pain characteristic (presence of pain and pain thatlast at least more than a day), it was found that the prevalence of multisite pain with sites defined as regions had a lower prevalence (33%) as compared to the one which defined the sites as each anatomical sites in the musculoskeletal systems (41%)[9,15]. Only one study looked at the 3-month prevalence of multisite pain (which were defined by the presence of painbased onseven anatomical sites) and found the prevalence of 73%[13].

For the three cohort studies in this review (Table 3),they were all heterogeneous in view of the definition of multisite pain and also in the duration of follow-up (1, 4 and 5 years). Theseimpaired the comparison between them. It was found that the occurrence of multisite paindefined by presence of pain based on 4 regions during the preceding week (for the period of 4 years) was 16% for new onset multisite pain and69% for persistent multisite pain[17]. For multisite pain defined by pain lasted more than 1 day based on 6 sites for the preceding one-month, the occurrence of new onset multisite pain for the period of 1 year was17% and 62% for persistent multisite pain[18].A study defining multisite pain as chronic pain lasted for 6 months based on 4 regions and confirmed with clinical signs showed very low occurrence of multisite pain about 8% for follow-up interval of 5 years[19].

Table 1: Descriptions of the studies in the review

Authors	Study design	Population studied	Response rate (total respondents)
Yeung et al. 2002	Cross-sectional	Male workers involving with manual handling	100% (217)
Haukka et al. 2006	Cross-sectional	Female kitchen workers	99% (495)
Solidaki et al. 2010	Cross-sectional	Nurses, office workers and clerks	95% (564)
Miranda et al 2010	Cross-sectional	General working population	80% (4,087)
Parot-Schinkle et al. 2012	Cross-sectional	General working population	90% (3,710)
Coggon et al. 2013	Cross-sectional	Nurses, office workers and others e.g. sugar cane cutter, flower plantation, mail sorters, clerks and machine operators	Response rate >80% for 33 of 47 occupational groups. Only 5 groups< 50%. (Total: 12,426)
Neupane et al. 2012	Cohort (Follow-up duration: 4 years)	Food industry workers	Baseline response rate: 60% Follow-up response rate: 72% Participated in both survey: 61% (Total: 734)
Solidaki et al. 2013	Cohort (Follow-up duration: 1 year)	Nurses, office workers and clerks	Baseline response rate: 95% Follow-up response rate: 90% Participated in both survey: 87% (Total: 518)
Herin et al. 2014	Cohort (Follow-up duration: 5 years)	General working population	Participated in both survey: 87% (Total: 18,695)

Table 2: Definition of multisite pain and its prevalence in the cross-sectional studies

Authors	Total sites	Anatomical sites	Characteristic of Pain	Prevalence
Yeung et al. 2002[12]	10	Fingers, wrists/hands, elbows or forearms, shoulders, neck, upper back, lower back, hips/upper legs, knees/lower legs and ankles/feet.	• Presence of pain (no/yes).	12-month: 64%
Solidaki et al. 2010[14]	6	Wrist/hand, elbow, neck, shoulder, low back and knee.	• pain for ≥1 day • pain that had lasted for ≥30 days in total • pain that cause difficulties in carrying out daily activities (disabling pain)	12-month: • 67% • 17% • 21%
Parot-Schinkel et al. 2012[16]	3	Upper limbs including neck, axial and lower limbs	• pain for ≥1 day • pain that had lasted for ≥30 days in total	12-month: • 65% • 19%
Miranda et al 2010[15]	4	Neck/shoulders, low back, upper limbs and lower limbs	• Presence of pain (no/yes).	1-month: 33%
Coggon et al. 2013[9]	10	Right wrist/hand, left wrist/hand, right elbow, left elbow, right shoulder, left shoulder, neck, low back, right knee and left knee,	• pain for ≥1 day	1-month: 41%
Haukka et al. 2006[13]	7	Hand/ forearms, shoulder, neck, low back, hip, knee and ankle/foot	• Presence of pain (no/yes).	3-month : 73%

Table 3: Definition of multisite pain and its occurrence in the cohort studies

Authors	Total sites	Anatomical sites	Characteristic of Pain	Occurrence of multisite pain
Neupane et al. 2012[17]	4	Hands/upper limbs, neck/ shoulders, low back and feet/lower limbs	• Presence of pain during the preceding week with the reply scale from 0 (not at all) to10 (very much). Each reply scale was dichotomized from the median to determine status of pain	• 54% (Baseline) • 50% (Follow-up) • 16% for new onset • 69% for persistent pain
Solidaki et al. 2013[18]	6	Wrist/hand, elbow, neck, shoulder, low back and knee.	• pain for ≥1 day in the past 12 months (baseline) • pain for ≥1 day in the past month (follow-up)	• 47% (at follow-up) • 17% for new onset • 62% for persistent pain
Herin et al. 2014[19]	4	Neck/shoulder, elbow/wrist/ hand, low back and hip/knee/feet	• No pain (baseline) • pain at least 6 months (current or intermittent) with positive clinical sign (functional limitation, tenderness and stiffness) (follow-up)	• 8.1% for new onset

The physical work exposures assessed

Five out of the nine studies were found to assess physical work exposures (Table 4a and Table 4b). In these studies, the physical work exposures assessed were either general characteristics of hazardous biomechanical factors without dictating the body sites exposed[17,19] or specific site-related physical work demands which were ultimately calculated as an item to a generalised physical loading index[9,14,18]. For the two studies that assessed physical work as exposure to the general hazardous biomechanical factors, they had considered factors such as forceful effort, awkward posture and repetitive work and both of them defined the sites as 4 regions (Table 4a).For the other group of studies, they had assessedfive to seven specific site/regional physical work exposures as the items for the physical loading index(Table 4aand Table 4b). In this group, the sites were defined as the individual anatomical sites and not as region. However, it was found that the number of specific site-related physical work exposures did not correlate to the number of sites considered in the definitions even thoughit was stated in one of the studies that each physical work items corresponded to one body site considered in the definition[13]. It was also noted that there were common authors in the studies with similar exposure assessments[9,14,18].

DISCUSSION

The review of the previous studies done on multisite pain among workers showed various ways of defining the multisite pain. The difference in the definition lies mainly in the body regions considered and the characteristic of the pain itself. It was found that the characteristic of the pain influenced the multisite pain prevalence more than how the sites were defined. Characteristic of pain which includes all form of pain severity (presence of pain or pain of 1 day or more) gave higher prevalence as compared to those definitions which focused on more chronic and debilitating pain. For the difference in the definition of sites considered, it was found that the prevalence did not differ as much when they were grouped together into regions or when each anatomical site of musculoskeletal system was considered. The findings of the cohort studies showed similar trends but comparison among these cohort studies were not appropriate since they were different not only in the definition of multisite pain but also on other aspects of the studies such as the follow-up period.

Table 4: Physical work exposures assessed in the studies of multisite pain among workers

Authors	Anatomical sites (No. of sites)	Physical risk factors studied
Neupane et al. 2012[17]	Hands/upper limbs, neck/ shoulders, low back and feet/lower limbs (4)	• awkward postures • repetitive work Exposure category: Low, moderate and high from Likert scale score
Herin et al. 2014[19]	Neck/shoulder, elbow/wrist/ hand, low back and hip/knee/feet (4)	• Forceful effort (Considerable physical effort) • Heavy loads (Carrying heavy loads) • Effort with tools (Physical effort with tools) • Posture (Long, difficult posture and awkward posture) • Movements (Precise movements and/or repetitive work • Vibration (Vibration and/or to jolts) Exposure category: binary dimension (yes/no)
Solidaki et al. 2013[18]	Wrist/hand, elbow, neck, shoulder, low back and knee (6)	Physical loading index 7 physical work demands were considered as strenuous physical activities (yes/no): • lifting weight 25kg or more by one hand • working with hand above shoulder height for more than one hour in total, • repeated bending and straightening of elbow for more than one hour in total • using of keyboard or typewriter for more than 4 hours in total • carrying out other repetitive tasks involving wrist and fingers for more than 4 hours in total • kneeling/squatting for more than one hour in total • climbing up and down for more than 30 flights of stairs. Exposure category: according to the number of physical work demand exposed (0 to 1, 2, 3 and ≥4)
Solidaki et al. 2010[14]	Wrist/hand, elbow, neck, shoulder, low back and knee (6)	Physical loading index 5 physical work demands were considered as strenuous physical activities (yes/no): • lifting more than 25 kg by hand - for physical exposure to low back • working with the hands above shoulder height for one hour or more in total - for physical exposure to neck and shoulder • repeated bending and straightening of elbow for more than one hour in total- for physical exposure to elbow • typing for more than 4 hours in total or doing other repeated movements of wrist and hands for more than 4 hours in total - for physical exposure to wrist-hand • kneeling or squatting for one hour in total - for physical exposure to knee Exposure category: according to the number of physical work demand exposed (0 to 5)
Coggon et al. 2013[9]	Right wrist/hand, left wrist/hand, right elbow, left elbow, right shoulder, left shoulder, neck, low back, right knee and left knee (10)	Physical loading index 5 physical work demands (yes/no): • lifting more than 25 kg by hand • working with the hands above shoulder height for one hour or more in total • repeated bending and straightening of elbow for more than one hour in total • use of computer keyboard or doing other repeated movements of wrist and hands for more than 4 hours in total • kneeling or squatting for one hour in total Exposure category: according to the number of physical work demand exposed (0 to 5)

For the physical work exposures, two groups of physical work exposures assessments have been identified. One was based on the general biomechanical factors without specifying the sites or region involved and the other looked at loading to the whole body based on multiple region-specific physical exposures.It is difficult to conclude whether the sites considered in the definition of multisite pain determined the physical work exposure assessed due to the small number of studies involved. Furthermore, some of the studies were conducted by similar team members which may explain the similar multisite pain definition and similar physical work exposures assessed.

Nevertheless, it is important to note that both groups of the physical work exposures might not be suitable in findings the physical risk factors which are of practical importance in the future surveillance and prevention programme of multisite pain at the workplace. Defining physical work exposures as general biomechanical characteristics (such as forceful effort, repetitive movement, vibration and awkward postures) would make it difficult to differentiate whether it involves only one physical work activityhaving the related biomechanical characteristicsor there are actually multiple work activitiesthat share similar biomechanical characteristic but act on the different sites of the body[20].Therefore, site-specific physical work exposures should be suggested in the research of multisite pain in order to identify the physical risk factors that need ergonomic intervention at the workplace.

The practice of assessing physical work exposure as generalized loading index may also cause difficulty in understanding whichindividual physical work activities behave as risk factors for multisite pain. This information is important in the prevention and control activities. Individual regional physical work exposures should be assessed individually as they may play significant role in multisite pain where widespread distribution of the pain is not the focused.The biological plausibility may render the less significant role of localized regional physical factors in the development of an extensive widespread distribution. However, it may not be the same for multisite pain with less extensive distribution. Many studies looking at pain at different sites or regions had indicated that physical factors influence pain at multiple sites but in a more restricted distribution as compared to psychological factors. Physical exposures of a site or region are more likely to be associated with pains at the adjacent sites or regions[21-22]. Therefore, individual regional physical work exposures may play a more important role in multisite pain as currently thought.

Another issue of using the physical loadingindex is that some of the work exposure items in the index had been shown to affect more than the region that it was meant to represent. Lifting weight more than 23 kilogram, for example, had been found to predict pain not only for low back region but also to the neck/shoulder region and lower limb region[21]. With this regards, perhaps some of the items in the index are associated with pain at only one site and others may be associated to more sites. Therefore, it is important to assess the relationship of each of the physical work exposure in this loading index with multisite pain and further conclude whether they are assessing what they are meant to assess. This is important in ensuring the validity of the loading index. Also, other than the physical work exposures that are itemised in this index, those that were commonly assessed in the studies of regional musculoskeletal pain should also be assessed to have a more comprehensive understanding of physical work exposures and multisite pain.

CONCLUSION

This review identified the different definitions of multisite pain used in the studies among workers. The difference mainly lies in the musculoskeletal sites considered and the characteristic of pain. It was found that the characteristics of the pain influenced the prevalence much more than the sites considered. For the physical work exposures, they were either assessed by the general biomechanical factors or by the degree of physical loading to the body. However, it is difficult to conclude whether the multisite definition used determined the selection of physical work exposure assessed due to the small number of studies and similar authors in some of the studies. It should be noted that the findings of this review could not beinferreddue to the limited number of studies. More studies need to be done to facilitate the future development of uniformed definition of multisite pain.

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