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ORIGINAL REPORT

INCIDENCE OF AND RISK FACTORS FOR MUSCULOSKELETAL SYMPTOMS IN THE NECK AND LOW-BACK DURING SEVERE FLOODING IN BANGKOK IN 2011

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Objective: **To examine whether the incidences of neck and low-back symptoms were elevated during the severe floods that occurred in Bangkok, Thailand in 2011, and to explore flood-related risk factors for neck and low-back symptoms.**
Design: **Prospective cohort design.**
Methods: **Severe flooding occurred in Bangkok and surrounding neighbourhoods between October and December, 2011. After the flood had subsided (January 2012), 377 healthy office workers, who were already taking part in a study on musculoskeletal symptoms, were asked about their contact with floodwater. Data were gathered from subjects, who had reported no neck and low-back symptoms at the end of September 2011 and who were affected by the flood. Two regression models for the outcomes of 3-month incidence of neck and low-back symptoms, respectively, were performed.**
Result: **Eighty-two percent of the subjects were affected by the flood. No flood-related factor was found to associate significantly with either neck or low-back symptoms. However, neck symptoms may be associated with commuting frequently through flooded areas, and low-back symptoms may be associated with the subjects' homes or workplaces being flooded.**
Conclusion: **These findings indicate that more attention needs to be paid to the problem of musculoskeletal symptoms during flooding in urban areas, and that preventive measures are required.**

Key words: floods; neck pain; low-back pain; office workers.

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INTRODUCTION

Global climate change is now widely recognized as a major environmental problem. As the temperature of the planet rises, there is increased risk of catastrophic flooding (1). The health effects of floods include an increased incidence of injuries, communicable diseases, exposure to toxic pollutants, malnutrition, and mental health disorders (1, 2). A recent survey of the health impacts of the devastating flood in Hanoi, Vietnam, revealed higher incidences of dengue fever, pink eye, dermatitis, and psychological problems in communities severely affected by flooding (3).

During the period July to December 2011, Thailand experienced severe floods in vast areas of the country. The most affected areas were central Thailand, including Bangkok and its surrounding neighbourhoods. The flooding began in northern Thailand in July and gradually flowed south towards Bangkok, which was most severely affected by inundation during October to December 2011. According to the Department of Disaster Prevention and Mitigation, of the Ministry of Interior, 65 out of 77 provinces were affected by the floods, which claimed the lives of 815 people and affected 2.9 million households (4). The World Bank reported that the total economic damage and losses from the floods are estimated to be more than $45.7 billion US dollars. This estimate does not include the damage and loss experienced by the police and military, whose resources were mobilized for flood prevention construction and humanitarian relief efforts (5).

People living in areas that are under threat of flooding or being flooded are at high risk of musculoskeletal symptoms because they are exposed to high-intensity and unfamiliar physical activities, which are identified as risk factors for developing musculoskeletal disorders (6, 7). People build or repair flood walls using sandbags or construction materials, relocate their belongings to high places, evacuate from their residential areas, walk through flooded areas for long distances, and use paddle boats for commuting. In addition, these people encounter various psychosocial problems, including stress, anxiety, depression, and interpersonal arguments. The role of psychosocial factors in the development of musculoskeletal symptoms is well recognized (8). To date, no study has reported on the incidence of musculoskeletal symptoms in flood victims.

At the time of the flooding in Bangkok, a prospective cluster-randomized controlled trial of the effect of an exercise programme on preventing musculoskeletal symptoms in the spine was being conducted in office workers from workplaces in Bangkok (still ongoing). As part of this study, office workers completed diaries detailing the incidence of musculoskeletal symptoms in the neck and low back. This allowed us to evaluate the impact of flooding on the incidence of neck and low-back symptoms.

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The aims of this study were to examine whether the incidence of musculoskeletal symptoms in the neck and low back were elevated during the floods and to explore flood-related risk factors for neck and low-back symptoms in a cohort of office workers. The information obtained will be of use in developing suitable protective and intervention measures to prevent musculoskeletal symptoms in the neck and low back among flood victims.

METHODS

Study population and procedures

In February 2011, a prospective cluster-randomized controlled trial was conducted to evaluate the effect of an exercise programme on musculoskeletal symptoms of the spine among healthy office workers, with a follow-up of 12 months. The study was approved by the Chulalongkorn University Human Ethics Committee. Office workers were defined as those working in an office environment in which their main tasks involve using a computer, participating in meetings, giving presentations, reading, and telephoning (9). Six large-scale enterprises in Bangkok were randomly assigned into either control or intervention groups. In each participating workplace, subjects were conveniently sampled. The enterprises were in the public transportation, infrastructure, and energy sectors. Inclusion criteria were: age 18–55 years; working full-time; at least 1 year of experience in their current position; and lower-than-normal neck flexor and back extensor endurance and lower-than-normal ranges of neck flexion and back extension movement. Exclusion criteria were: reported musculoskeletal symptoms in the spine in the previous 6 months; reported pregnancy or planning to become pregnant in the next 12 months; a history of trauma or accidents in the spinal region, or a history of spinal, intra-abdominal and femoral surgery in the previous 12 months. Subjects who performed regular exercise or who had been diagnosed with congenital anomaly of the spine, rheumatoid arthritis, infection of the spine and discs, ankylosing spondylitis, lumbar spondylolisthesis, lumbar spondylosis, tumour, systemic lupus erythematosus, or osteoporosis were also excluded from the study. Prior to participation in the study, all subjects gave their informed consent in writing.

An invitation letter and information about the study were sent to office workers in 6 workplaces. Those who expressed interest and were eligible were invited to participate in the study. At baseline, a self-administered questionnaire was distributed to each subject by hand and the researcher returned to collect the completed questionnaire 15 min later. Subjects then underwent a physical examination. Those who were eligible for the study were assigned to either control or intervention groups. Subjects in both groups received a self-administered diary to record the incidence of musculoskeletal symptoms in the neck and low back. The researcher returned to collect the diaries and to check that they were correctly completed every month for a 12-month period. However, by the start of October 2011, the flood gradually affected most areas in Bangkok and surrounding neighbourhoods, making it impossible for the researcher to return to the workplaces to collect the diaries. Thus, the last report on incidence of musculoskeletal symptoms received before flooding was for September 2011. After the flood had subsided (January 2012), the researcher visited the study population at their workplaces and asked them to complete a self-administered questionnaire designed to gather data about flood-related factors, as well as retrospectively completing a dairy for the period October to December 2011.

Questionnaire

The self-administered questionnaire at baseline comprised 3 sections designed to gather data on individual, work-related physical and psychosocial factors. Individual factors included gender, age, marital status, educational level, frequency of regular exercise or sport, smoking habit, and number of hours driving a day. Work-related physical factors included current job position, number of working hours, and years of working experience. Respondents were asked about the frequency of using a computer, performing various activities during work, and rest breaks. The questionnaire also asked respondents to self-rate the ergonomics of their workstations and work environment conditions. Psychosocial factors were measured with the Job Content Questionnaire Thai version (JCQ Thai version) (10).

Flood-related factors in the post-flooding questionnaire included how subjects were affected by the flood (their home, workplace, surrounding neighbourhood, or whether none were flooded), living in the flooded area (yes or no), and commuting through the flooded areas (yes or no).

Diary

The diary was used to gather data on the incidence of musculoskeletal symptoms in the spine during the past month. Subjects were asked to answer the yes/no question "Have you experienced any neck or low-back pain lasting >24 h during the past month?" If they answered "Yes", follow-up questions about pain intensity measured by a visual analogue scale (VAS), the presence of weakness or numbness in the relevant limbs, and the cause of symptoms were asked. In this study, subjects were identified as cases whenever from baseline measurement they answered "Yes" to the above question, reported pain greater than 30 mm on a 100-mm visual analogue scale, and had no weakness or numbness in the relevant limbs. Those identified as cases were not followed up any further. The areas of neck and low back were defined according to the standardized Nordic questionnaire (11).

The following information was also sought from those who reported the incidence of musculoskeletal symptoms: disability levels measured by the Thai version of the Neck Disability Index (NDI) (12) for neck symptoms and the Thai version of the Roland-Morris Disability Questionnaire (RDQ) (13) for low-back symptoms.

Statistical analyses

The flooding period in Bangkok and surrounding neighbourhoods was defined as the period between October and December 2011, and the pre-flooding period was defined as between February and September 2011. Since the length of the follow-up period during the pre-flooding period was not uniform for all participants, the person-time incidence, defined as the number of new cases of impairment during a period of time divided by the person-time-at-risk throughout the observation period, of neck and low-back symptoms were estimated to compare the incidences between the pre-flooding and flooding periods.

Data for subjects from a prospective cluster-randomized controlled trial, who reported no neck and low-back symptoms at the end of September 2011 and who were affected by the flood, were entered in 2 regression models for the outcomes of 3-month incidence of neck and low-back symptoms (i.e. the period between October and December 2011), respectively. Predictors included in both models were: age, gender, control vs exercise group, frequency of commuting through flooded areas (<5 days/week vs ≥ 5 days/week), and flooding of workplace or residence. Enter selection procedures were used in the statistical modelling. Odds ratios (OR) associated with particular factors were adjusted for the effect of all other factors in the models. Adjusted ORs and 95% confidential interval (CI) for the final models are presented. Statistical significance was set at the 5% level. All statistical analyses were performed using SPSS statistical software, version 17.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

Of the total of 2,400 office workers who received a letter inviting them to participate in the study, 1,860 (78%) responded. Of these, 563 were eligible and 435 agreed to participate at baseline measurement. A total of 377 (87%) office workers were contacted after the flood had subsided (January 2012), while 58 (13%) could not be contacted during the data collection period, i.e. the first 2 weeks of January 2012. These subjects contributed a total of 216 person-years of observations for neck symptoms and 223 person-years of observations for low-back symptoms. Most of the participating subjects (310 from 377; 82%) were reportedly affected by the flood.

Incidence of neck and low-back symptoms

The person-year incidence of neck symptoms during the pre-flooding period was 1.7-fold greater than that during the flooding period, whereas the person-year incidence of low-back symptoms during the pre-flooding and flooding periods were similar (Table I). The severity of neck and low-back symptoms between the pre-flooding and flooding periods were similar ($p = 0.514$ for neck symptoms and $p = 0.814$ for low-back symptoms). The difference in disability level due to neck and low-back symptoms failed to reach a significant level ($p = 0.063$ for neck symptoms and $p = 0.053$ for low-back symptoms).

Association between 3-month incidence of neck symptoms and flood-related factors

When multivariable logistic regression was applied, no factor was found to be significantly associated with the 3-month incidence of neck symptoms. However, the findings showed that the frequency of commuting through flooded areas may correlate with the incidence of neck symptoms ($p = 0.076$). The frequency of commuting through flooded areas was scaled into 2 groups (< 5 days a week and ≥ 5 days a week). Subjects who commuted through flooded areas ≥ 5 days a week were at greater risk of experiencing neck symptoms compared with those who commuted through flooded areas < 5 days a week (adjusted OR = 2.57, 95% CI = 0.91–7.32) (Table II).

Association between 3-month incidence of low-back symptoms and flood-related factors

When multivariable logistic regression was applied, no factor was significantly associated with the 3-month incidence of low-back symptoms. However, it was shown that the home or workplace being flooded may correlate with complaints of low-back symptoms ($p = 0.074$). Workers who reported their home or workplace being flooded were at greater risk of experiencing low-back symptoms than those who reported neither their home nor workplace being flooded (adjusted OR = 3.32, 95% CI = 0.89–12.38) (Table II).

Table I. *Person-year incidence of musculoskeletal symptoms in the neck and low back during pre-flooding and flooding periods, with reported severity and disability levels*

Body regions	Incidence Cases/100 person-year	VAS Median (IOR)	NDI/RDQ Median (IOR)
Neck symptoms			
Pre-flooding period	36	4.4 (1.6)	5.0 (8.0)
Flooding period	21	4.1 (1.0)	7.5 (8.8)
p-value		0.514	0.063
Low-back symptoms			
Pre-flooding period	21	4.4 (1.0)	2.0 (1.8)
Flooding period	22	4.3 (2.1)	5.0 (4.0)
p-value		0.814	0.053

NDI: Neck Disability Index; RDQ: Roland-Morris Disability Questionnaire; IOR: interquartile range; VAS: visual analogue scale.

Table II. *Three-month incidence and adjusted odds ratio (ORadj) with 95% confidence intervals (95% CI) of neck and low-back symptoms with respect to flood-related factors in the final modelling*

Factors	*n*	3-month incidence *n* (%)	ORadj	95% CI	*p*
Neck symptoms[a]					
Age	215		1.00	0.96–1.05	0.892
Gender					
Male	75	9 (12)	1.00		
Female	140	11 (8)	0.56	0.20–1.51	0.250
Group assignment					
Control group	127	13 (10)	1.00		
Exercise group	88	7 (8)	0.941	0.32–2.79	0.912
Frequency of commuting through flooded areas					
< 5 days a week	163	10 (6)	1.00		
≥ 5 days a week	52	8 (15)	2.57	0.91–7.32	0.076
Residence or workplace being flooded					
No	88	6 (7)	1.00		
Yes	127	14 (11)	2.47	0.74–8.21	0.142
Low-back symptoms[a]					
Age	214		1.00	0.95–1.05	0.906
Gender					
Male	74	8 (11)	1.00		
Female	140	14 (10)	1.19	0.44–3.27	0.725
Group assignment					
Control group	132	9 (7)	1.00		
Exercise group	82	13 (16)	2.37	0.84–6.71	0.105
Frequency of commuting through flooded areas					
< 5 days a week	162	13 (8)	1.00		
≥ 5 days a week	52	7 (13)	2.27	0.79–6.57	0.130
Residence or workplace being flooded					
No	88	3 (3)	1.00		
Yes	126	19 (15)	3.32	0.89–12.38	0.074

[a]Factors included in the statistical modelling were: age, gender, control vs exercise group, frequency of commuting through flooded areas, and flooding of workplace or residence.

DISCUSSION

To the best of our knowledge, this is the first study to investigate the incidence of neck and low-back symptoms during severe flooding and the relationships between the incidence of such symptoms and flood-related factors. The study population was office workers and the epidemiological literature indicates that, among office workers, the 1-year incidence of neck pain is in the range 34–49% (14–16) and the 1-year incidence of low-back pain is 23% (17). The 1-year incidence of neck and low-back pain reported in the present study during the pre-flooding period was in line with previous studies (14–17), indicating that the study sample was a good representation of the office worker population.

The 1-year incidence of neck and low-back symptoms during the flooding period was higher than that for the general population in non-disaster circumstances. This observation may be attributed to the effect of severe flooding. Although the magnitude of difference was rather small ($\geq 6\%$), the actual number of individuals experiencing neck or low-back symptoms due to flooding is likely to be significant because severe flooding affects millions of people and there is an increased risk of catastrophic flooding in the future as a result of climate change (1). The economic consequences of treating those with flood-related neck and low-back symptoms can be substantial, because evidence suggests that a significant portion of patients with neck and low-back pain develop chronicity (18, 19).

Although the difference between the severity of neck and low-back symptoms during the pre-flooding and flooding periods was negligible, subjects were likely to report a greater disability level associated with such symptoms during the flooding than the pre-flooding periods. It is well documented that psychosocial factors have an influence on low-back pain, disability, and persistent symptoms (20, 21). However, the association between disability level and psychosocial factors for neck pain is not as strong (22). Feng et al. (23) found that approximately 10% of individuals who were affected by floods in Hunan, China, were diagnosed as having post-traumatic stress disorder. Recently, Bich et al. (3) reported a higher incidence of psychological problems in communities severely affected by floods compared with in unaffected communities. Thus, it is likely that the psychological impact of a flood may lead to increased disability levels due to neck and low-back symptoms during the flood.

Although no flood-related factors were found to associate significantly with neck symptoms, the results of this study suggest that commuting through flooded areas ≥ 5 days a week increased the risk of experiencing neck symptoms compared with commuting through flooded areas < 5 days a week. The item "frequency of commuting through flooded areas" can be interpreted in many different ways. One possible interpretation may relate to an increase in performing upper extremity activities. Walking or driving through flooded areas takes much longer than walking or driving on dry land. Long walks mean prolonged carrying of belongings. Some individuals may need to use a paddle boat for commuting. During the flood, a large proportion of people commuted through flooded areas using military trucks, which have very high chassis. Getting on and off this type of vehicle requires a lot of muscle strength in the upper extremities. Thus, performing these activities frequently, or performing them for prolonged periods may lead to injuries to the neck and upper extremities.

No flood-related factors were found to correlate significantly with low-back symptoms. However, the findings suggest an increased risk of low-back symptoms in those who reported either their home or workplace as being flooded. People living in areas under threat of flooding or being flooded are exposed to high-intensity and unfamiliar physical activities, such as building flood walls using sandbags, and lifting heavy objects. The process of building flood walls usually involves using a shovel to scoop sand from the ground into bags and carrying them from one place to another. Each sandbag normally weighs approximately 20–30 kg. These activities are repeated for long periods because a lot of sandbags are required to build the walls. Consequently, the process of building flood walls may lead to excessive loads on the lower back. In addition, people living in flood-prone areas usually relocate their belongings to high places or to the second floor of their house. Lifting heavy objects is well recognized as a common cause of low-back pain, as the spine is exposed to high compression forces, and high anterior shear forces, especially in the lower lumbar segments, during lifting (24).

These findings highlight a need for stakeholders to pay more attention to the problem of musculoskeletal symptoms during flooding in urban areas in order to reduce the incidence of neck and low-back symptoms among flood victims. The prevention of neck and low-back symptoms among those who are likely to be affected by flooding should at least focus on advising the public how to perform several high-intensity and unfamiliar physical activities safely during the flood, such as building or repairing flood walls using sandbags or construction materials, relocating belongings to high places, evacuating from residential areas, walking through flooded areas for long distances, and using paddle boats for commuting.

There are a number of methodological limitations of this study. First, the findings of the present study should be taken as a preliminary result because the sample size was relatively small, increasing the likelihood of a type II error. Secondly, the use of a sample of healthy office workers, who provided a reasonably homogeneous population, restricts generalization of the results of this study to a general population. In order to validate the findings of this study, further research with the general population is required. Thirdly, in this study, subjects were identified as cases if they reported pain greater than 30 mm on a 100-mm visual analogue scale and pain lasting more than 1 day. Different results may emerge with different definitions of symptomatic cases. Fourthly, musculoskeletal symptoms were diagnosed based upon subjective information only, which may lead to inaccurate diagnosis. Future studies should consider the inclusion of information from a physical examination in order to increase the accuracy of diagnosis. Finally, the association between flood-related factors and musculoskeletal symptoms was based on cross-sectional data. Thus, it is not possible to establish the causal relationship between exposure and outcome. However, conducting a prospective study amid the disaster would be extremely difficult.

In conclusion, the current study found an increased rate of musculoskeletal symptoms in the neck and low back during severe flooding in Bangkok and its surrounding vicinity in 2011. The disability level due to neck and low-back symptoms during the flood was greater than during non-disaster circumstances. Some activities during the flood may lead to the development of neck and low-back symptoms, including building flood walls using sandbags, relocating belongings to higher places, and commuting frequently through flooded areas. Musculoskeletal symptoms in flood victims should be taken into consideration because they may lead to substantial economic consequences. One effective preventive measure may be to educate people who are living in areas under threat of flooding how to perform high-intensity and unfamiliar physical activities safely during floods.

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