# Risk factors for repetitive strain injuries among school teachers in Thailand

Sunisa Chaiklieng[a,c,*] and Pornnapa Suggaravetsiri[b]
[a] *Department of Environmental Health Science, Faculty of Public Health, Khon Kaen University, Muang Khon Kaen 40002, Thailand*
[b] *Department of Epidemiology, Faculty of Public Health, Khon Kaen University, Khon Kaen 40002, Thailand*
[c] *Back, Neck and other Joint Research Group, Khon Kean University, Thailand*

**Abstract.** Prolonged posture, static works and repetition are previously reported as the cause of repetitive strain injuries (RSIs) among workers including teachers. This cross-sectional analytic study aimed to investigate the prevalence and risk factors of RSIs among school teachers. Participants were 452 full-time school teachers in Thailand. Data were collected by the structural questionnaires, illuminance measurements and the physical fitness tests. Descriptive statistics and inferential statistics which were Chi-square test and multiple logistic regression analysis were used. Most teachers in this study were females (57.3%), the mean years of work experience was 22.6 ± 10.4 years. The six-month prevalence of RSIs was 73.7%. The univariate analysis identified the related risk factors to RSIs which were chronic disease (OR=1.8; 95% CI = 1.16-2.73), history of trauma (OR=2.0; 95% CI = 1.02-4.01), member of family had RSIs (OR=2.0; 95% CI = 1.02- 4.01), stretch to write on board (OR=1.7; 95% CI = 1.06-1.70) and high heel shoe >2 inch (OR=1.6; 95% CI = 1.03-2.51). Multiple logistic regression analysis showed that chronic diseases and high heel shoe >2 inch significantly related to developing of RSIs. The poor grip strength and back muscle flexibility significantly affected RSIs of teachers. In conclusions, RSIs were highly prevalent in school teachers that they should be aware of health promotion to prevent RSIs.

Keywords: musculoskeletal disorders, ergonomics, prevalence

## 1. Introduction

Persisting musculoskeletal disorders (MSDs) is common in society. Eighty percent of people have experienced back pain at some time in life. The annual prevalence of back pain in general ranges from 15% to 45% with point prevalence averaging 45% [1]. The disorders can happen with anyone, any age, and any occupations. The previous reported risk factors to MSDs include awkward posture, prolonged posture, heavy lifting, manual handling, and work environment [1, 2]. Repetitive strain injury (RSIs) is one type of MSDs affected to the area of upper limb, neck, shoulder and low back. The disorder is one of the leading causes for ill health retirement among school teachers [3]. The job nature of school teachers in Thailand may involve a lot of head down posture, such as frequent reading, assignment correction, and writing on board. Activities of sustained sitting in front of computer, standing up teaching in class, repetitively overhead writing on board are also unsafe act found in teachers [4-6]. Most of the previous studies did not emphasize on the minor risks to RSIs [7], particularly in school teachers. Since RSIs are caused by multi-factors. Each factor is connected to musculoskeletal pain differently. Findings of risk factors for RSIs in Thai school teachers would be able to suggest ways for prevention. Therefore the objectives of this study were to investigate the prevalence and risk factors of RSIs among school teachers[*].

---

[*]Corresponding author e-mail: csunis@kku.ac.th

## 2. Methods

This cross-sectional analytic research was designed to investigate prevalence and risk factors of RSIs among school teachers in Nakhonphanom province, Thailand. Data were collected by face-to face-interview with structural questionnaires, the measurement of light intensity and physical fitness test. The surveys were conducted from December 2009 – March 2010.

### 2.1 Subjects

The population consisted of 718 school teachers from 54 different schools (including secondary school and primary schools) in Thatphanom district, Nakhonphanom province, Thailand. By simple one-stage cluster sampling method, there were 452 teachers who met the study criteria i.e. full time school teacher, had a minimum of one year teaching experience, no injury or any disorders related to cervical, thoracic, or lumbar spine such as rheumatoid arthritis, degenerative disc disease, etc., no disability by birth, no pregnant and volunteer. In this study, RSIs was defined as a pain occurs partly or entirely on neck, shoulders, hand/arm, back muscles, spine.

### 2.2 Questionnaires and measurements

The structural questionnaires were applied from Chaiklieng et al. [8] and Peachtree spine and Pain physicians [9]. Questionnaire shown a valid and good reliability test with Cronbach's alpha of 0.79 for severity of pain, focused on following 3 parts;

Part 1: Demographic characteristics were age, gender, education level, marital status, part time jobs, income, debts, job position, year of teaching experience, school classes.

Part 2: Health Status were health behaviors (drinking coffee, exercising, wearing high heel shoe), history of trauma, congenital and chronic diseases, body mass index (BMI), waist circumference.

Part 3: Work characteristics were break time, number of teaching class, number of students in class, levels of students, teaching posture, etc.

Lighting intensity was measured by using light meter (model 401036) at 41 workstations of teacher's office and 116 workstations of classrooms.

Physical fitness test were performed for measurements of the hand grip strength, back strength, and back muscle flexibility by the standard instruments and procedure recommended by the sport science.

### 2.3 Data processing and analysis

Data were recorded by Epi-Info. for windows, Taxas, USA 2007 by method of double data entry, analysis by STATA Version 10 (Khon Kean University's Copy Rights). Descriptive statistics were used to describe the characteristics and six-month prevalence of RSIs. The associations of the developing RSIs with several individual factors, health status as well as a set of physical risk factors were examined by Chi-square tests or Fisher's exact tests, whichever were more appropriate. Factors with p-value less than 0.25 in chi square tests or Fisher' s exact were selected to be candidate variables in multiple logistic regression models. Significant risk factors were screened in a backward stepwise manner using likelihood ration tests as a selection criterion. Odds ratio (OR) and 95% confident interval (95% CI) were presented and p-value <0.05 indicated statistical significant. This study was approved by the appropriated institutional ethical review committee, Khon Kaen University, Thailand, No. HE522322.

## 3. Results

### 3.1 Personal factors

The study found that most teachers were females (260 or 57.3%), and married (79.0%). The mean age was 46.7 years (SD=8.5, min=20, max=59) and the majority of educational level was bachelor degree (85.2%). Most teachers had no other jobs besides teaching (74.3%), had monthly income 30,001-40,000 THB (41.7%) and had debt (92.3%). The mean years of teaching experience was 22.6 years (SD=10.4, min =1, max = 39).

### 3.2 Health status

According to standard of nutritional status [10], 142 teachers or 31.4% were classified as obese state by oversize waist circumference (males >90 cm, females >80 cm). When compared to the standard BMI, most teachers were classified as obese state for 43.1% (>25.0 kg/m$^2$), normal state (18.5-25.0 kg/m$^2$) for 48.5% and underweight (<18.5 kg/m$^2$)

for 8.4%. Some teachers had history of trauma (accident during last 10 years) for 14.8% and had chronic diseases (47.1%). From all reported chronic diseases, most were asthma and diabetes (18.8%), high blood pressure (16.2%) and peptic ulcer (13.9%). The member of family of most teachers had back pain (65.5%) and almost teachers never took sick leave for back pain (92.0%). Some had regular exercise or more than twice a week (38.4%). Most of exercises were jogging 35.2% and walking 21.2%. Most teachers drank coffee (67.0%). From the physical fitness test, most teachers had the physical function of muscle (hand grip/back strength and back muscle flexibility) lower than standard recommend by the institute of Sport Science.

### 3.3 Work characteristic and work environment

Teachers taught continuously 4.3 hours per day in average (SD=1.5 hours), had a break during classes for 78.5%. On average, the number of break was 2.1 times per day (SD=1.1), the period of each break was 28.5 minutes (SD=23.4 minutes) and the numbers of students per class was 25 persons (SD=8.1). Teaching posture were mostly switched between standing and sitting (78.8%), followed by only standing (18.1%) and the less was only sitting (3.1%). Teachers had complaint of getting back pain from using computers (41.8%) while 35.8% had to stretch to write on boards. Considering the Illuminance accorded to the classroom/office standard (400 lux) and the computer use office (600 lux) [11], the surveys identified that 33 workstations in teacher's office (80.5%) and 94 workstations in classrooms (81.0%) had light intensities lower than the minimum standard requirement as shown in Table 1.

### 3.4 Related factors to RSIs among school teachers

The six-month prevalence of RSIs was 73.7% (333/452). The highest prevalence was low back pain (54.4%), followed by shoulder (41.6%), upper back pain (36.1%), neck pain (34.5%) and arm pain 27.9%, respectively. The prevalence of RSIs was 74.5% among men and 73.1% among women. There was no significant difference in prevalence of RSIs among age groups or genders or different work experience groups (Table 2).

From physical fitness parameters, the development of RSIs significantly correlated with poor right hand grip and back muscle flexibility of

teachers at p=0.045 and p=0.025, respectively (Table 3). The univariate analysis showed that health-related factors were significantly correlated with RSIs. Teachers who had history of trauma as well as teachers with chronic disease had about 2.0 times higher risk to the development of RSIs compared to healthy teachers. Also, if their family members got RSIs, they had 2.0 times higher risk to the development of RSIs compared to the healthy family (Table 2).

Concerning behavioral and work-related factors, wearing high heel shoe >2.0 inch was related to the development of RSIs (p=0.037, OR=1.6, 95% CI=1.03-2.51). Working posture by stretching to write on the board significantly related to RSIs (p=0.028, OR=1.7, 95% CI=1.06-1.70). Even though, gender, age, work experience were not the confounders in this study, odds ratio were adjusted for all factors with p-value less than 0.25 by multiple logistic regression analysis. This study found that factors of chronic diseases and high heel shoe were risk factors for developing of RSIs among teachers (Table 4).

## 4. Conclusions and discussion

In this cross-sectional study, information bias was minimized by using a valid and reliable questionnaire. The high prevalence of RSIs found in Thai school teacher support some previous reports regarding MSDs among teachers [5,6,12]. This highest prevalence was at the area of low back confirms the study among school teacher in Malaysia [12]. Concerning the health status, this study indicated that teachers with chronic disease had significantly 1.6 times higher risk for developing RSIs compared to without chronic disease. This factor was supported by univariate analysis that teachers who had history of trauma or had family member got RSIs had the potential risk to developing RSIs as well. Moreover, more than 40% of teachers in this study were obesity and medium age which were conditions of health risk for illness. Regarding behavioral factor, it is very interesting that teachers wore high heel shoe had about 2 times higher risk for developing of RSIs compared to no high heel shoe. From work characteristics, teachers had to hold several classes each day with a short break. Therefore long period standing with high heel shoe might be one cause of low back pain as previous reports in general people.

Concerning work conditions, this study showed the hazard conditions of insufficient lighting in the classroom and teacher's office. Although, no previous studies reported the association between local lighting and musculoskeletal disorders, insufficient illuminations can force workers to adopt awkward posture in order to see better the work, this might lead to musculoskeletal pain or cause RSIs later on [14]. Lighting intensity at workstations should be adjusted to meet with the standard for office and working type [11].

Awkward posture by sustained muscle stretching, particularly overhead posture, induced neck and upper limb disorders in teachers [6]. This study also found that potential health risk of teachers who had stretched to write on boards during class. The boards and workstation should be designed to suit the figure of the teachers to avoid repetitively overhead work which is one cause RSIs [15].

It is unavoidable that teachers have to hold long hours of working with many classes per day, get a short breaks between classes, write on the boards, which all possibly affect to RSIs. However, knowledge and practice to prevent RSIs by working in the safe posture can reduce the risk of RSIs in the long term. By the matter of that poor muscle strength and back flexibility significantly related to the developing RSIs in this study, therefore teachers are suggested to avoid the risk by awareness of health promotion with regular exercise and continuous health monitoring.

## 5. Suggestions for next study

Since this study found the high prevalence of RSIs among school teachers, there should be occupational health surveillance and health monitoring program for RSIs prevention among school teachers. To reduce the re-call bias and information bias, the prospective cohort study is suggested for further study to identify work-related risk factors for RSIs among school teachers.

## Acknowledgement

## Reference

[1] G.B.J. Andersson, Epidemiological features of chronic low-back pain. The Lancet 1999; 354: 581-585.

[2] L. Punnett and D.H. Wegman, Work-related musculoskeletal disorders: the epidemiologic evidence and the debate. Journal of Electromyography and Kinesiology 2004; 14: 13-23.

[3] M. Maguire and T. O'Connell, Ill-health retirement of schoolteacher in the republic of Ireland. Occupational Medicine 2007; 57(3): 191-193.

[4] M. Praphasanon, Back pain manual. 3$^{rd}$ ed., Bangkok: Health & Well Being Publishing, 2006.

[5] T.W. Chiu, K.T. Lau, C.W. Ho, M.C. Ma, T.F. Yeung and P.M. Cheung, A study on the prevalence of and risk factors for neck pain in secondary school teacher, Public Health 2006; 120: 563-565.

[6] T.T.W. Chiu and P.K.W. Lam, The prevalence of and risk factors for neck pain and upper limb pain among secondary school teacher in Hong Kong. Journal of Occupational Rehabilitation 2007; 17: 19-32.

[7] A. Budor and G. Sorock, Positive and negative evidence for risk factors of work-related back disorders. The Scandinavian Journal of Work, Environment & Health 1997; 23: 243-256.

[8] S. Chaiklieng, P. Suggaravetsiri, Y. Boonprakob and B. Muktaphant, Prevalence of back pain and work environment factor among Khon Kaen university office workers, Safety and Environment Review 2009; 19(3): 11-18.

[9] Peachtree spine and Pain physicians, Pain Questionnaire 2003, [cited 2009 August 11] Available from URL: /docs/questionnaire.pdf.

[10] Department of Health, Ministry of Public Health, Working health promotion manual, 6$^{th}$ ed., Nonthaburi: Ministry of Public Health, 2007.

[11] Department of Labour Protection and Welfare, Ministry of Labour, Thailand. Regulation on the standard of management of safety, occupational health and work environment; heat, light and sound, version 2006. [cited 2010 October 20]. Available from: http://www.labour. go.th/law/index. htm.

[12] N.I.A. Samad, H. Abdullah, S. Moin, S.B.M. Tamrin and Z. Hashim, Prevalence of Low back pain and its risk factors among school teachers, American Journal of Applied Sciences 2010; 7(5): 634-639.

[13] S. Muto, T. Muto, A. Seo, T. Yoshida, K. Taoda and M. Watanabe, Prevalence of and risk factors for low back pain among staff for physically and mentally handicapped children, 2005, [cited 2009 July 14]. Available from URL: http://www.jniosh.go .jp/old/niih/en/ indu/indhealth _44_1_123.pdf.

[14] S. Chaiklieng, P. Suggaravetsiri and Y. Boonprakob Work ergonomic hazards for musculoskeletal pain among university office workers, Walailak Journal of Science and Technology 2010; 7(2): 169-176.

[15] E.B. Holmstrom, J. Lindell and U. Mortiz. Low back and neck/shoulder pain in construction workers: occupational workload and psychosocial risk factors, Spine 1992; 17(6): 672-677.

Table 1

Light intensity at work stations of teacher's office and classroom

| Light Intensity (lux) | Number (Spots) | Percentage |
|---|---|---|
| Teacher's office (n = 41) | | |
| < 400 | 17 | 41.47 |
| 400-600 | 16 | 39.02 |
| > 600 | 8 | 19.51 |
| Classrooms (n = 116) | | |
| < 400 | 94 | 81.03 |
| 400-600 | 19 | 16.38 |
| > 600 | 3 | 2.59 |

Table 2

Univariate of relationship between RSIs and selected factors

| Factors | RSIs; n (%) (n1=333) | No RSIs ; n(%) (n2 = 119) | OR | 95%CI | p-value |
|---|---|---|---|---|---|
| Gender | | | | | |
| Male | 143 (74.48) | 49 (25.52) | 1.08 | 0.73-1.64 | 0.738 |
| Female | 190 (73.08) | 70 (26.92) | 1.00 | | |
| Age group (year) | | | | | |
| > 40 | 267 (74.58) | 91 (25.42) | 1.25 | 0.75-2.06 | 0.393 |
| <= 40 | 66 (70.21) | 28 (29.79) | 1.00 | | |
| Teaching experience (year ) | | | | | |
| <=20 | 127 (74.27) 206 | 44 (25.73) | 1.05 | | |
| > 20 | (73.31) | 75 (26.69) | 1.00 | 0.68-1.62 | 0.822 |
| Chronic disease | | | | | |
| Yes | 170 (79.44) | 44 (20.56) | 1.78 | 1.16-2.73 | 0.008* |
| No | 163 (68.49) | 75 (31.51) | 1.00 | | |
| History of trauma (accident during last 10 years) | | | | | |
| Yes | 57 (83.82) | 11 (16.18) | 2.03 | 1.02-4.01 | 0.039* |
| No | 276 (71.88) | 108 (28.13) | 1.00 | | |
| Regular Exercise | | | | | |
| No | 210 (75.27) | 69 (24.73) | 1.24 | 0.81-1.90 | 0.328 |
| Yes | 123 (71.10) | 50 (28.90) | 1.00 | | |
| Coffee drinking | | | | | |
| Yes | 227 (75.17) | 75 (24.83) | 1.26 | 0.81-1.95 | 0.307 |
| No | 106 (70.67) | 44 (29.33) | 1.00 | | |
| Member of family had RSIs | | | | | |
| Yes | 121 (78.57) | 33 (21.43) | 2.03 | 1.02-4.01 | 0.042* |
| No | 212 (71.14) | 86 (28.86) | | | |
| Shoe height >1 inch | | | | | |
| Yes | 140 (79.10) | 37 (20.90) | 1.61 | 1.03-2.51 | 0.037* |
| No | 193 (70.18) | 82 (29.82) | 1.00 | | |
| Teaching posture | | | | | |
| Prolonged sitting or standing | 71 (73.96) | 25 (26.04) | 1.02 | 0.61-1.70 | 0.943 |
| Alternated sitting and standing | 262 (73.60) | 94 (26.40) | 1.00 | | |
| Working with Computer | | | | | |
| Yes | 276 (72.06) | 107 (27.94) | 0.54 | 0.28-1.05 | 0.070 |
| No | 57 (82.61) | 12 (17.39) | 1.00 | | |
| Shoe height >2 inch | | | | | |
| Yes | 140 (79.10) | 37 (20.90) | 1.61 | 1.03-2.51 | 0.037* |
| No | 193 (70.18) | 82 (29.82) | 1.00 | | |
| stretching to write on board | | | | | |
| Yes | 130 (79.75) | 33 (20.25) | 1.67 | 1.06-1.70 | 0.028* |
| No | 203 (70.24) | 86 (29.76) | 1.00 | | |

* statistic significant at p-value < 0.05

Table 3

Relationship between RSIs and physical fitness factors (n=109)

| Physical fitness test | RSIs ; n(%) | No RSIs ; n(%) | p-value |
|---|---|---|---|
| Left hand grip (kg) | | | |
| Low | 82 (93.18) | 6 (6.82) | 0.174 |
| Normal | 16 (80.00) | 4 (20.00) | |
| Good | 1 (100.00) | 0 (0.00) | |
| Right hand grip (kg) | 77 (91.67) | 7 (8.33) | 0.045* |
| Low | 19 (95.00) | 1 (5.00) | |
| Normal | 3 (60.00) | 2 (40.00) | |
| Good | | | |
| Back strength (kg) | | | |
| Low | 72 (91.14) | 7 (8.86) | 0.805 |
| Normal | 24 (88.89) | 3 (11.11) | |
| Good | 3 (100.00) | 0 (0.00) | |
| Flexibility (cm) | | | |
| Low | 33 (94.29) | 2 (5.71) | 0.025* |
| Normal | 45 (95.74) | 2 (4.26) | |
| Good | 21 (77.78) | 6 (22.78) | |

*statistic significant at p<0.05

Table 4

Multi logistic regression analysis of relationship between RSIs to selected factors

| Factors | RSIs (%) | OR (95%CI) | OR$_{adj}$ (95%CI) | p-value |
|---|---|---|---|---|
| Gender | | | | |
| Male | 143 (74.48) | 1.08 (0.73-1.64) | 1.51 (0.92-2.47) | 0.100 |
| Female | 190 (73.08) | | | |
| Age (year) | | | | |
| > 40 | 267 (74.58) | 1.25 (0.75-2.06) | 1.31 (0.67-2.59) | 0.431 |
| <= 40 | 66 (70.21) | | | |
| Teaching experience (year) | | | | |
| <=20 | 127 (74.27) 206 | 1.05 (0.68-1.62) | 0.64 (0.35-1.56) | 0.140 |
| > 20 | (73.31) | | | |
| Chronic disease | | | | |
| Yes | 170 (79.44) | 1.78 (1.16-2.73) | 1.63 (1.03-2.57) | 0.036* |
| No | 163 (68.49) | | | |
| History of trauma (accident during 10 years) | | | | |
| Yes | 57 (83.82) | 2.03 (1.02-4.01) | 1.91 (0.94-3.91) | 0.074 |
| No | 276 (71.88) | | | |
| Member of family had RSIs | | | | |
| Yes | 121 (78.57) | 2.03 (1.02-4.01) | 1.21 (0.74-1.96) | 0.448 |
| No | 212 (71.14) | | | |
| Working with computer | | | | |
| Yes | 276 (72.06) | 0.54 (0.28-1.05) | 0.54 (0.27-1.08) | 0.081 |
| No | 57 (82.61) | | | |
| Shoe height >2 inch | | | | |
| Yes | 140 (79.10) | 1.61 (1.03-2.51) | 1.66 (1.01-2.75) | 0.050* |
| No | 193 (70.18) | | | |
| Stretch to write on board | | | | |
| Yes | 130 (79.75) | 1.67 (1.06-2.64) | 1.48 (0.96-2.39) | 0.110 |
| No | 203 (70.24) | | | |

* statistic significant at p<0.05