Ergonomics risk and neck shoulder back pain among dental professionals

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Abstract

This research was conducted to assess the ergonomic risks, the prevalence and incidence of neck shoulder back (NSB) pain among dental professionals. Subjects were 193 dentists and dental nurses working in government hospitals in Thailand. Data were collected by BRIEF (Baseline Risk Identification of Ergonomic Factors)'s survey and interviewing with the structured questionnaires. Subjects were followed-up for six-month to identify the new case of NSB pain. BRIEF’s survey indicated high risk from scaling (78.8%), filling (77.7%) and tooth extraction task. Neck, followed by back area was indicated for the highest proportion on high ergonomic risk from scaling and filling task. Back pain was the highest prevalence occupied in 58.5% of participants during the previous month before beginning the cohort study. Most workers had most complaint about combination of three sites (neck, shoulder, and back) for the onset of pain (36.3%). The cohort study indicated the highest incident shoulder pain in 1- and 3- month follow-up at 15.6% and 22.9%, respectively. For 6-month follow-up, back pain was shown to be the highest incident (42.1%), followed by shoulder pain. In conclusion, NSB pain was obviously musculoskeletal health problems as a group of pain symptoms among Thai dentists and dental nurses. Each scaling, filling task indicated high ergonomics risk predominantly located on neck and back areas. 6-month incidence of NSB pain could confirm the serious musculoskeletal health problems from exposure to ergonomics risk factors. Therefore, dentists and dental nurses should be aware of NSB pain development. The hospital should support workstations and dental tools with ergonomic designs to fit to individual and task.

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Keywords: BRIEF; Neck shoulder back pain; Dentist; Dental nurse; Prevalence; Incidence

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1. Introduction

Musculoskeletal pains are common in society and obvious problem related to occupation as work related musculoskeletal disorders (WMSDs). The symptoms are prevalent among workers involved physical exertion work and sedentary work. The sedentary work is defined as occasionally lifting no more than ten pounds, and sitting with occasional walking and standing. The prolonged sitting, awkward posture, repetitive motions are physical ergonomic factors related to WMSDs [1, 2]. The postures can be observed for assessment of ergonomics risk factors. Rapid Upper Limbs assessment (RULA) is a quick assessment tool for posture of neck, trunk and upper limbs along with muscle function and external loads [3]. For entire body, REBA (Rapid Entire Body Assessment) had been developed for a practitioners’s field tool to the type of unpredicted working postures in health care and service industries [4]. Another technique is Baseline Risk Identification of Ergonomics Factor (BRIEF), a simple technique, which was developed for a survey of nonspecific part of body [5]. Analyses of ergonomic risks by this tool consider posture, force, duration and physical ergonomics from hazards of for example vibration, cold, light, and cumulative working hour of workers. This physical ergonomics and load related to upper limb disorders and shoulder pain among dental professionals [6].

Dental nurses and dentists are types of health care professional required a high skill job and prolonged sitting to perform daily task. Repetitive movements of upper limbs while bending trunk forwards to focus on small work pieces for oral health care of patient possibly are work ergonomic factors. Back pain was highest complaint among WMSDs in dentists that ranged from 36.3% to 60.1% followed by neck pain ranged from 19.8% to 85.0% [7].

Previous study in United State America reported the recent 12-month prevalence of neck pain and shoulder pain among dentists that were 73% and 65%, respectively [8]. The study in Thai dental professional from governmental hospital in Khon Kaen province presented also the high prevalence of neck, back and shoulder pains [9]. However, there is still no assessment on ergonomics risk among dental professionals, this study therefore aimed to assess the ergonomics risk and to investigate the prevalence and incidence of neck, shoulder and back pains among dental professionals in Thailand.

2. Materials and methods

This research was carried out in dentists and dental nurses from government hospitals in Khon Kaen province, Thailand. There were 193 dentists and dental nurses who met the study criteria included into the study and ergonomics risk identification by BRIEF™ survey was performed for the baseline evaluation of ergonomic factors from 85 representative dental nurses or dentists from 85 government hospitals. Sub-district health promoting hospital, local district and tertiary hospital in Khon Kaen hospitals were included into this study by system sampling with considering the contribution numbers of hospitals from each size representative hospital and dental section. This study obtained ethical approval from Khon Kaen University ethics committee, Thailand, no. HE552042 and all participants gave informed consent prior to entering the study.

2.1. Participants and data collection

Data were collected by applied techniques the BRIEF (Baseline Risk Identification of Ergonomic Factors) survey for the ergonomics risk assessment and face-to-face interviewed questionnaire. Neck, shoulder and back pain experience was asked for the base line prevalence in order to exclude subjects who had experience of moderate to severe symptom of neck, shoulder and back pain from a group of cohort study. In the cohort study, the workers who had pain experience on neck, shoulders and back areas from moderate to severe symptom were excluded before starting a prospective cohort follow-up. The baseline evaluation was performed by risk assessment with BRIEF survey. Baseline screening data was collected by face to face interviews with the structured questions based on Chaiklieng et al. [10]’s questionnaire which was divided into 3 parts. Part 1 enquired about demographic characteristics i.e. age, gender, work experience, second job or part time job. Part 2 enquired about health status, history of trauma and accidents affecting musculoskeletal health, congenital diseases and chronic diseases affecting
musculoskeletal health. Part 3 enquired about the current shoulder, neck and back (NSB) pain, a history of an episode of care of NSB pain in the previous months or any specific medical condition.

Subjects who met inclusion criteria for the cohort study were followed-up every 15 days for six months to identify the new case of shoulder, neck and back (NSB) pain. During the 6 month follow-up, the primary question that was asked at each 15 day-follow-up was: "Have you experienced any NSB pain lasting more than 24 hours during the past 15 days (Y/N)?", applied from Hush et al. [11]. If a participant reported any onset of NSB pain, more information was sought regarding date of onset, treatment sought, pain affecting work and daily activities and work loss. A positive response to any of the following questions confirmed that the NSB pain was work-related: 1) Did your NSB pain start at work? 2) Did your NSB pain result from an injury or event at work? 3) Have you submitted a worker's compensation claim for this NSB pain? 4) Did your health care provider specify that this is a work-related injury? In the event of a participant reporting an episode of NSB pain, he/she continued to be followed up for a further period of one month to establish the severity of NSB pain on the basis of health professional consultation or the period of work absence. If a subject reported the NSB pain that was deemed not to be work-related (e.g. following an injury occurring outside of work hours), the subject was withdrawn from the study. If appropriate, advice to consult a health care practitioner was provided. The incidence rate was calculated at the period of 6-month follow-up in this study.

2.2. Data analysis

Data were recorded by Epi-info for Windows using a method of double data entry and the analysis was performed using STATA version 10.1 (Texas, USA, 2007). The descriptive statistics were used for data analysis and identified the feature functions and anatomical positions at the highest risk level. Prevalence and incidence of neck, shoulder and back pains were calculated by the following formula;

The recent month prevalence = (number of neck, shoulder and back pain cases x 100) / 193

Incidence= (number of new cases of neck or shoulder or back pain x 100) / total subjects in each cohort group

In the cohort group, the total subjects of neck pain study was 107 participants, of shoulder pain was 96 participants and of back pain was 114 participants.

Ergonomics risk score with BRIEF survey was given in ordinal scale and this score was from observation of working posture of neck, shoulders and back together with loading or force holding, duration and frequency [12]. The final score was classified into three levels of risk for each dental task i.e. scaling task, filling task, tooth extraction task and each part of body and as following:

1) Low risk level (score = 0 or 1) is acceptable risk
2) Medium risk level (score = 2 or 3) is unacceptable risk, further investigation
3) High risk level (score = 3 or 4) needs more investigation and implement change

3. Results

3.1. Personal characteristics of dental professionals

The results showed that, among 193 dental professionals, most of them were female (80.3%), aged between 20 to 59 years (median = 30 years), 46.1% had work experience less than 6 years (median = 7 years; min - max = 0.5 - 33 years).

3.2. Ergonomics risk by BRIEF identification among dental professionals

BRIEF survey identified at 85 workplaces and showed that dental nurses and dentists had the highest ergonomics risk at level 3 (high risk level) on neck area, followed by back and hands/wrists, respectively. Considering the feature function of dental professionals, the highest risk was found on the same area of body for scaling task and filling task which were neck (78.8% and 77.7%), followed by back (75.3% and 72.9%) and hands/wrists (61.2% and
43.6%), respectively as shown in Table 1. However, for tooth extraction task, the highest proportion of workers at high risk was identified on area of back, followed by neck and elbows at 69.4%, 61.1% and 30.6%, respectively.

Considering the ergonomics risk for the development of neck, shoulder and back pain, the highest frequency of high risk identification was observed on neck area while performing of scaling task (78.8%) and filling task (77.7%), followed back area from scaling task and filling task. Back posture initiated the highest risk from BRIEF survey among other parts of body while performing of tooth extraction task, however, it was presented in lower proportion compared to scaling and filling task as shown in Table 2.

Table 1. Ergonomics risk identification by BRIEFTM survey among dental professionals (n = 85).

| Task of work       | Risk level | hand/wrist\(^1\) n (%) | elbow n (%) | shoulder n (%) | neck\(^1\) n (%) | back\(^2\) n (%) | leg n (%) |
|--------------------|------------|-------------------------|-------------|----------------|----------------|----------------|-----------|
| Scaling task       | low        | 18 (21.2)               | 85 (100)    | 85 (100)       | 18 (21.2)      | 19 (22.3)      | 72 (84.7) |
|                    | medium     | 15 (17.6)               | 0 (0.0)     | 0 (0.0)        | 0 (0.0)        | 2 (2.4)        | 10 (11.8) |
|                    | high       | 52 (61.2)\(^3\)        | 0 (0.0)     | 0 (0.0)        | 67 (78.8)\(^1\) | 64 (75.3)\(^2\) | 3 (3.5)   |
| Filling task       | low        | 20 (23.5)               | 85 (100)    | 81 (95.3)      | 8 (9.4)        | 15 (17.7)      | 76 (89.4) |
|                    | medium     | 28 (32.9)               | 0 (0.0)     | 0 (0.0)        | 11 (12.9)      | 8 (9.4)        | 7 (8.2)   |
|                    | high       | 37 (43.6)\(^3\)        | 0 (0.0)     | 4 (4.7)        | 66 (77.7)\(^1\) | 62 (72.9)\(^2\) | 2 (2.4)   |
| Tooth extraction task | low     | 81 (95.3)               | 43 (50.6)   | 83 (97.7)      | 13 (15.4)      | 16 (18.8)      | 77 (90.6) |
|                    | medium     | 1 (1.2)                 | 16 (18.8)   | 0 (0.0)        | 20 (23.5)      | 10 (11.8)      | 5 (5.9)   |
|                    | high       | 3 (3.5)                 | 26 (30.6)\(^3\) | 2 (2.3)      | 52 (61.1)\(^2\) | 59 (69.4)\(^3\) | 3 (3.5)   |

Remark: 1 is the 1\(^{st}\) ranking order of highest risk and 2, 3 are the following orders of the top 3 of highest risk in each task.

Table 2. Ergonomics risk identification by BRIEFTM survey on neck, shoulder and back pain among dental professionals (n = 85).

| Task of work       | Risk level | Neck n (%) | Shoulder n (%) | Back n (%) |
|--------------------|------------|------------|----------------|------------|
| Scaling task       | low        | 18 (21.2)  | 85 (100)       | 19 (22.3)  |
|                    | medium     | 0 (0.0)    | 0 (0.0)        | 2 (2.4)    |
|                    | high       | 67 (78.8)\(^1\) | 0 (0.0)      | 64 (75.3)\(^3\) |
| Filling task       | low        | 8 (9.4)    | 81 (95.3)      | 15 (17.7)  |
|                    | medium     | 11 (12.9)  | 0 (0.0)        | 8 (9.4)    |
|                    | high       | 66 (77.7)\(^2\) | 4 (4.7)      | 62 (72.9)\(^4\) |
| Tooth extraction task | low     | 13 (15.4)  | 83 (97.7)      | 16 (18.8)  |
|                    | medium     | 20 (23.5)  | 0 (0.0)        | 10 (11.8)  |
|                    | high       | 52 (61.1)  | 2 (2.3)        | 59 (69.4)\(^3\) |

Remark: 1 is the 1\(^{st}\) ranking order of highest risk and 2, 3, 4 and 5 are the following ranking orders of top 5 of the highest risk.

### 3.3. Prevalence of neck, shoulder and back pains among dental professionals

According to NSB pain, back pain occupied in 58.5% of dental personals as the highest prevalence at baseline assessment during the recent month before starting the 6-month cohort study. In addition, workers had more complaint of moderate to severe level of muscle pain on combined three sites of body, which were neck, shoulder, and back pains (36.3%) compared to only one or two sites as shown in Table 4.
Table 3. One month prevalence of neck, shoulder and back pains among dental professionals (n=193).

| Duration                  | Neck n (%) | Shoulder n (%) | Back n (%) |
|---------------------------|------------|----------------|------------|
| 1-month prevalence        | 99 (51.3)  | 108 (56.0)     | 113 (58.5) |

Table 4. Combination sites (neck, shoulder and back) of pain complaint by dental professionals during the previous month (n=193).

| Number of sites of pain complaint | n (%) |
|----------------------------------|-------|
| 0 (no pain)                      | 44 (22.80) |
| 1 (one site of pain)             | 33 (17.10)  |
| 2 (two sites of pain)            | 46 (23.83)  |
| 3 (three sites of pain)          | 70 (36.27)   |

3.4. Incidence of neck, shoulder and back pains among dental professionals

For the six months follow-up of NSB pain, the total subjects were started in different numbers because only subjects met inclusion criteria of no pain experience on those parts of body at moderate to severe level. The highest incidence was found for shoulder pain at the 1st and 3rd month (15.6% and 22.9%). At the end of six-month follow-up, the highest incidence of pain was indicated on back area (42.1%), followed by shoulder pain (34.4%) as shown in Table 5.

Table 5. Incidence of neck, shoulder and back pains among dental professionals.

| Duration of the follow up | Neck (n = 107) n (%) | Shoulder (n = 96) n (%) | Back (n = 114) n (%) |
|---------------------------|----------------------|-------------------------|----------------------|
| 1-month incidence         | 10 (9.4)             | 20 (15.6)               | 11 (9.6)             |
| 3-month Incidence          | 19 (17.8)            | 22 (22.9)               | 24 (21.1)            |
| 6-month Incidence          | 30 (28.0)            | 33 (34.4)               | 48 (42.1)            |

4. Discussion

The assessment of ergonomics risk by BRIEF survey indicated the highest ergonomics risk level of scaling task among dental professional. Previous study explained that the nature of this task required hand holding the small equipment and finger depression with repetitive motion of hand/wrist during scaling task [7]. Using vibration instruments was another one factor, which caused NSB pain as reported by previous study [7, 13]. By prolong sitting at least 40 minutes per one patient and holding physical load while extend flexion of neck and trunk and poor posture to focus on work pieces or teeth of patients related to NSB pain among dental professional [7, 9, 14]. BRIEF survey also indicated the top three areas of highest risk from working postures, which were neck, back and hand/wrist areas. These might be explained by the high prevalence of neck, shoulder and back pain complaint among dentists and dental nurses in this study as well as previous report in Thai dental professional [9].

In addition, this study found site combination of pain presented as highest prevalence from 3 combined sites (neck, back and shoulders), followed by 2 sites combination for pain initiation. That identification could support the previous systematic reviews reporting these top three areas of highest WMSDs complaint [7, 8, 9]. By the short-term followed-up, shoulder pain was presented as the highest incidence compared to neck pain and back pain. This was inconsistent with the highest risk area indicated by BRIEF. However, it was not a big surprised finding because the
combination site of pain was indicated on areas of neck and shoulder as mentioned before. Interestingly, the longer period of 6 months follow-up, back pain was shown up to present as the highest incident, followed by shoulder pain. This might be explained by BRIEF identification on exposure to the high ergonomics risk for NSB pain development. Since the characteristics of awkward postures, cumulative hours, frequent repetition movement of upper limbs and prolonged static posture were indicated predominantly on those areas in the dental professionals, long term exposure on these ergonomic factors might play important role on the development of neck shoulder back pain in this study.

5. Conclusions and recommendation

NSB pain was obvious prevalent in dental professional and shown in high complaint rate for the combination sites of more than on site of pain among Thai dentists and dental nurses, and here, back pain was the highest complaint. By the reason that each dental professional could not avoid a high demand teeth care for scaling and filling task, which might cause high ergonomics risk for the NSB pain development. Additional six months follow-up indicated that back pain was the highest incidence, followed by shoulder pain, which were consistent with high risk identification by BRIEF survey and the report of NSB pain prevalence. Therefore, dentists and dental nurses should be aware of prevention of NSB pain development after long term exposure to ergonomic risk factors. The hospital should support good ergonomics workstation and ergonomic tools, which were designed to fit to individual and task.

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