Socio-Demographic and Physical Factors Associated with Disability in Adults with Non-Specific Chronic Neck Pain

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ABSTRAK
Walaupun faktor sosio-demografi, fizikal dan faktor lain dikaitkan dengan sakit leher, terdapat sedikit data tentang bagaimana faktor-faktor ini dikaitkan dengan ketidakupayaan dalam kalangan orang dewasa yang menderita dari keadaan ini. Kami bertujuan untuk menentukan faktor sosio-demografi dan fizikal (kekuatan dan julat pergerakan sendi) yang menyebabkan ketidakupayaan pada orang dewasa yang mengalami sakit leher yang tidak spesifik. Sejumlah 34 orang dewasa yang mengalami sakit leher dengan purata umur 55 (10.80) tahun dari klinik fisioterapi di hospital pengajaran mengambil bahagian dalam kajian ini. Butiran sosial-demografi seperti indeks jisim badan, status pekerjaan semasa, jumlah jam senaman dilakukan seminggu telah diperoleh. Tahap kesakitan dinilai menggunakan Skor Penilaian Numerikal (Numerical Rating Scale, NRS). Tahap ketidakupayaan dinilai dengan menggunakan Indeks Ketidakupayaan Leher (Neck Disability Index). Julat pergerakan servikal diukur dengan menggunakan alat pengukur pergerakan servikal. Dinamometer tangan digunakan untuk mengukur kekuatan genggaman tangan dominan. Data dianalisis menggunakan analisis deskriptif dan regresi linear berlangkah. Lebih separuh daripada peserta yang mengalami kesakitan leher dalam kajian ini adalah perempuan, di atas 50 tahun, dalam kumpulan kelebihan berat badan (jisim berat badan >25 kg/m²), kini mengangur dan mengalami sakit leher yang teruk (Skor Penilaian Numerikal >7). Kekuatan tangan adalah satu-satunya
faktor yang didapati signifikan (p<0.05) yang berkaitan dengan ketidakupayaan leher. Keputusan dari kajian kami ini menunjukkan bahawa pengkondisian dan peningkatan kekuatan otot adalah penting untuk mencegah ketidakupayaan leher dalam kalangan orang dewasa yang mengalami sakit leher yang tidak spesifik.

Kata kunci: faktor, fizikal, ketidakupayaan, sakit leher, sosio-demografi

ABSTRACT

While socio-demographic, physical and other factors are associated with neck pain, there is scanty literature about how these factors are associated with disability in adults suffering from this condition. We aimed to determine the socio-demographic and physical (strength and range of motions) related factors of disability in adults with non-specific chronic neck pain. A total of 34 adults with neck pain, with mean age 55 (10.80) years from a physiotherapy clinic in a teaching hospital participated in this study. Socio-demographic details such as body mass index (BMI), current employment status, hours of exercise done a week were obtained. Severity of pain was evaluated using the Numerical Rating Scale (NRS). Disability level was assessed using Neck Disability Index. Cervical range of motion was measured using the Cervical Range of Motion device. A hand dynamometer was used to measure the dominant hand grip muscle strength. The data was analyzed using descriptive and stepwise linear regression analysis. More than half the participants were females, above 50 years, in the overweight group (BMI>25 kg/m²), currently unemployed and had severe neck pain (NRS >7). Handgrip strength was the only factor found to be significantly (p<0.05) related to neck disability. The results from our study suggest that improving general muscle conditioning and strength are important in preventing neck disability among adults with non-specific neck pain.

Keywords: factors, disability, neck pain, physical, socio-demographic

INTRODUCTION

Chronic pain is a personal burden affecting at least half of the general population often resulting in poor quality of life, workforce productivity and escalated healthcare expenditure. (Johnston 2016; Mäntyselkä et al. 2001; Langley et al. 2010). Neck pain is experienced by a third of the global population at some point in their lives (Pool et al. 2007). About 6% of Malaysian adults suffer from this condition (Veerapen et al. 2007). Neck pain can be categorized into specific and non-specific neck pain (NSNP), with the latter being the more common concern (Rezai et al. 2009). NSNP results from poor posture and other mechanical causes and does not involve neurological deficit (Binder 2007).
Many factors related to neck disability require more in-depth understanding. Socio-demographically, the literature indicates that the incidence of NSNP increases with age, higher body mass index (BMI) and is higher among women (Genebra et al. 2017; Hoy et al. 2010). The prevalence of neck pain has been found to vary among occupations, neck pain being higher among employed individuals and professionals especially desk job workers (Nilsen et al. 2011) compared to retirees and housewives (Chiu & Leung 2006). This illustrates the association of neck pain with work-related risk factors. However, the association of neck pain and exercise remains unclear. It was demonstrated that there was a significant association between NSNP and exercise (Nilsen et al. 2011), while another study (Briggs et al. 2009) showed contradictory results.

Neck disability is one of the most commonly acknowledged adverse effects of neck pain (Farooq et al. 2018). World Health Organization (WHO 2018) has defined disability as an umbrella term comprising of impairment, activity and participation restriction. Previous studies have shown a fair to moderate correlation between neck pain and disability (Howell 2011). However, disability is not caused solely by pain itself but also by other physical, physiological, psychosocial and environmental factors (Fejer & Hartvigsen 2008). Physical aspects, such as cervical range of motion (ROM), has been found to be affected among those suffering with neck pain (Malik et al. 2017). However, the direct relationship between cervical range of motion and neck disability has not been studied in depth. Cervical range of motion (ROM), predominantly craniovertebra (CV) angle, deteriorates as intensity of neck pain increases (Rudolfssson et al. 2012). The smaller the CV angle, the greater the forward head posture (FHP). Persistent FHP can gradually lead to disability (Lindstrøm et al. 2011; Yip et al. 2008).

Altered neck posture may subsequently result in the shortening and overstretching of neck muscles leading to chronic pain (Nilsen et al. 2011). Similarly, accessory muscle activation during upper limb tasks was found to be altered in adults with neck pain (Tsang et al. 2014). Increased muscle activation is inversely proportional to neck muscle strength (Lindstrøm et al. 2011). When assessing strength, handgrip strength has been used as an indicator of overall strength and general health. It reflects the maximum strength derived from the combined contraction of extrinsic and intrinsic hand muscles (Mitsionis et al. 2009). It has been suggested that head-neck posture may influence handgrip strength (Kumar et al. 2012). However, information regarding the relationship between muscle strength, neck disability and other socio-demographic factors determined in a single model is limited.

To date, evidence related to socio-demographic and physical risk factors of neck pain and disability is inconsistent. In addition, most of the studies were conducted in homogenous populations such as students or professionals. Thus, the results of these studies may not be
applicable to adults with NSNP seen in clinical settings. The aim of the present study was to determine the socio-demographic and associated physical factors of disability among adults with NSNP.

MATERIALS AND METHODS

In this cross-sectional study, 34 participants with NSNP were recruited, using convenient sampling, from the Physiotherapy Department at Hospital Chancellor Tuanku Muhriz, Universiti Kebangsaan Malaysia. Ethical approval was obtained from the research and ethics committee of Universiti Kebangsaan Malaysia (UKM1.21.3/244/NN-2016-069) and written informed consent was obtained from participants. This study included adults aged 18-65 years who had experienced NSNP for more than 3 months. Those with medical conditions such as spinal cord compression, tumor, fracture, instability, inflammatory disease, infection, congenital or acquired postural deformities (e.g., kyphosis, scoliosis), neurological deficits and who had undergone neck surgery were excluded from the study. The sample size was calculated using GPower 3.1. The effect size of association was obtained from Fejer & Hartvigsen 2008, $f^2=0.38$. The result of the sampling size was 34.

Eligible participants provided their socio-demographic details in a questionnaire and they completed the Neck Disability Index (NDI). The socio-demographic questionnaire comprised of questions on age, ethnicity, gender, BMI, employment status and exercise level. The participants were also asked in person about their current employment status and the number and forms of exercise they did a week. The Numerical Rating Scale (NRS) was used to measure intensity of pain (Childs et al. 2016). It has high correlation with visual analogue scale (VAS), correlation ranging between 0.86-0.95 (Ferraz et al. 1990). This scale was reported to have high correlation with chronic pain conditions with a value 0.86 (Downie et al. 1978). It is a single 11-point numerical scale in which the participants were asked to indicate the numeric value that best describes the intensity of their pain on the segmented scale with ‘0’ representing no pain and ‘10’ the worst pain (Hjermstad et al. 2011). Pain intensity scores of 1 to 3 indicate mild pain intensity, scores of 4 to 6 indicate moderate pain intensity and scores of 7 to 10 indicate severe pain intensity (Serlin et al. 1995).

Neck Disability Index (NDI) is reliable on “test-retest” reliability, ICC=0.86 (Vernon 2008) and ICC=0.84 among those with mechanical neck pain (Young et al. 2009). It consists of 10 items, each with a score up to 5 and a total score of 50. The lower the score, the lesser the self-rated disability. After obtaining permission, we used the English version of NDI in our study.

The Hand Grip Test (HGT) was assessed using a hand dynamometer (Jamar Hand dynamometer, Patterson Medical, Canada). The HGT is found to be a reliable ICC=0.98 and valid ICC=0.99 tool in measuring handgrip strength (Bellace et al. 2000). It has been widely used to predict functional outcomes among
healthy, post-operative and also post-stroke adults (Bohannon et al 2006). Handgrip strength measurement using a manual hand dynamometer has been suggested to be a reliable measurement tool to measure global muscle strength (Chan et al. 2014). The ICC ranges between 0.87-0.97 among those with cervical radiculopathy and neck muscle strength among cervical radiculopathy (Peolsson et al. 2001). It correlates strongly with upper limb strength (Bohannon 1998) and weakly with neck pain (Ylinen et al. 2003).

The HGT was performed with the participant sitting on a chair (back against the chair, both feet flat on the floor with hip and knees positioned at 90° angles). The participant’s dominant shoulder was adducted and neutrally rotated, elbow flexed at 90°, forearm neutral, wrist held between 0-15° of ulnar deviation. The participant held the dynamometer vertically in their dominant hand in line with the forearm and squeezed the grip bar as hard as they could. Three successive readings were taken with an interval of 15 seconds between each session (International Occupational Therapy 2002). The mean of the three measurements were proceeded with data analysis (Fried et al. 2001; Werle et al. 2009).

Cervical Range of Motion was measured using a Cervical Range of Motion Device (CROM Deluxe, USA). In all movement planes, CROM device yielded a test-retest reliability, ICC ranging between 0.89 to 0.98. Among healthy individuals, CROM has been found to have an excellent validity (ICC=0.93-0.98) (Audette et al. 2010; Tousignant et al. 2006). Participants were instructed to be seated in a relaxed position with back against the chair, both feet flat on the floor, hip and knees positioned at 90° angles. The CROM device was placed on the participants’ foreheads, secured using a velcro strap and adjusted to a neutral position. The participants were then required to perform the following movements:

i. Flexion-Participants were asked to bend their heads forward maximally (flex).

ii. Extension-Participants were asked to bend their heads backwards maximally (extend).

iii. Right and left lateral flexion-Participants were asked to bend their heads towards the right and then the left.

iv. Right and left rotation-Participants were asked to turn their heads towards the right and then the left.

Three readings were recorded for each type of movement and the mean was calculated.

**DATA ANALYSIS**

Data was analysed using SPSS version 22 (IBM SPSS Statistics V22.0). The socio-demographic details, GHQ-28, NDI, cervical ROM and handgrip strength were analyzed using descriptive analysis. Shapiro-Wilk test, stem and leaf plot and histogram plots showed that all the continuous data were normally distributed. Stepwise Linear Regression was used to determine the socio-demographic variable, cervical range of motion (flexion, extension, right flexion, left
| Variables                        | N  | %    | Mean  | Standard deviation |
|---------------------------------|----|------|-------|--------------------|
| **Age (years)**                 |    |      |       |                    |
| 30-40                           | 4  | 11.8 | 55.00 | 10.80              |
| 40-50                           | 7  | 20.6 |       |                    |
| 50-60                           | 10 | 29.4 |       |                    |
| 60-70                           | 13 | 38.2 |       |                    |
| **Gender**                      |    |      |       |                    |
| Males                           | 11 | 32.4 |       |                    |
| Females                         | 23 | 67.6 |       |                    |
| **Race**                        |    |      |       |                    |
| Malay                           | 25 | 73.5 |       |                    |
| Chinese                         | 6  | 17.6 |       |                    |
| Indian                          | 3  | 8.8  |       |                    |
| **Body Mass Index (kg/m²)**     |    |      |       |                    |
| Normal                          | 16 | 47.1 | 25.38 | 3.09               |
| Overweight                      | 18 | 52.9 |       |                    |
| **Current Employment Status**   |    |      |       |                    |
| Employed                        | 14 | 41.2 |       |                    |
| Retired                         | 20 | 58.8 |       |                    |
| **Hours of Exercise per week**  |    |      |       |                    |
| 0                               | 7  | 20.6 | 1.41  | 1.02               |
| 1                               | 12 | 25.3 |       |                    |
| >2                              | 6  | 17.6 |       |                    |
| **Pain (NRS 0-10)**             |    |      |       |                    |
| 1-3 (mild)                      | 0  | 0    | 6.64  | 1.39               |
| 4-6 (moderate)                  | 10 | 29.4 |       |                    |
| 7-10 (severe)                   | 24 | 70.6 |       |                    |
| **Neck Disability Index (NDI)** | 17.03 | 5.14 |       |                    |
| **Psychological Distress (GHQ-28)** | <24 | 44.1 | 31.18 | 10.97               |
| >24                             | 19 | 55.9 |       |                    |
| **Cervical ROM (°)**            |    |      |       |                    |
| Flexion                         | 44.56 | 15.31 |       |                    |
| Extension                       | 42.18 | 10.96 |       |                    |
| Left flexion                    | 28.14 | 10.21 |       |                    |
| Right flexion                   | 27.47 | 9.73  |       |                    |
| Left rotation                   | 46.50 | 17.35 |       |                    |
| Right rotation                  | 47.12 | 14.94 |       |                    |
| **Dominant handgrip strength (kg)** | 19.47 | 8.08  |       |                    |
flexion, right rotation and left rotation) and dominant handgrip strength with NDI. Prior tests showed that normality, linearity and homoscedasticity of residuals assumptions had been met. All the socio-demographic (employment status, BMI, hours of exercise, pain level) and physical (cervical flexion, extension, right flexion, left flexion, right rotation and left rotation) factors were keyed in stepwise multiple linear regression test as independent variables and NDI as dependent variable.

RESULTS
Table 1 shows the socio-demographic details of the participants. Most participants were older adults aged 60 years and above, female, Malay, overweight and unemployed (retirees and housewives). The NRS score showed that more than two thirds of the participants suffered from severe pain (NRS Score 7-10) and the rest reported moderate pain level. The Neck Pain Disability Index (NDI) mean score was 17.03 (5.14). The mean range of motion of cervical as well as dominant handgrip strength was tabulated in Table 1.

Only handgrip strength appeared to be a significant factor related to neck disability among adults with non-specific neck pain (Table 2). Handgrip strength accounted for 45% (R^2=0.21, adjusted R^2=0.18, F(1,32)=8.03, p=0.007) of neck disability. One kg increase in handgrip strength reduced NDI score by 0.29 times, (B=-0.29). The effect size computed from this regression analysis is Cohen's f^2=0.3, which is of medium effect size.

DISCUSSION
Our study examined the socio-demographic and physical factors related to disability among adults with non-specific chronic neck pain. The findings of the study suggested that improved muscle strength reduced the risk of disability among those with non-specific chronic neck pain.

There was a significant relationship between handgrip strength and neck disability in our study. A decline in handgrip strength has been shown to be inversely proportional to disability (Taekema et al. 2010). Reduction in handgrip strength is related to a decline in general muscle strength that slows down recovery process (Lenardt et al. 2016). Moreover, prolonged and continuous use of the dominant hand has been found to trigger increased cervical and shoulder muscle tension (Mustafa & Sutan 2013). This gradually leads to pain, reduced range of motion on the ipsilateral side and eventually increase in disability (Ylinen et al.)

| Type of Personality | B   | Beta  | 95% CI    |
|---------------------|-----|-------|-----------|
| (Constant)          | 24.93 | -     |           |
| Dominant handgrip   | -0.29* | -0.45 | -0.49 – (-0.09) |

N = 34, CI = confidence interval, *P<0.05
Our study did not find exercise to be a significant factor related to neck disability ($p>0.05$). We believe that muscle strength may have accounted for exercise in our model. It should be noted that clinical practice guidelines and systematic review (Gross et al. 2007; Kay et al. 2015; Philadelphia Panel Evidence-Based Clinical Practice Guidelines 2001; Verhagen et al. 2007) have recommended exercise as an effective intervention to decrease pain and disability among people with chronic neck pain.

In addition, it has been reported that adults with neck pain had decreased disability scores after strength and endurance exercise training (Nikander et al. 2006; Chiu et al. 2004). Regular exercises gradually increases muscle strength and aerobic capacity which help to reduce disability (Felício et al. 2017; Hardy & Grogan 2009). These findings are consistent with ours. General and strengthening exercises have the potential to increase general wellbeing (Gross et al. 2007; Chodzko-Zajko et al. 2009) and decrease fear avoidance (Cheung et al. 2013). Therefore, for optimal outcome, strengthening exercises should be emphasized among adults with NSNP.

Severity of pain was not a significant factor for neck disability in our study. Adults with chronic pain may have effectively adapted, using compensatory strategies, to continue their activities of daily living (Sturgeon & Taub 2016). This non-significant relationship between severity of neck pain and disability could also have been accounted for by other factors that were not addressed in our study.

None of the cervical movements appeared as factors related to neck disability in our study. It should be noted that weak, unilateral side flexion (Kumbhare et al. 2005) and active cervical range of motion in sagittal and transverse planes (Piva et al. 2006) have been associated with neck disability. Similarly, Gustavsson et al. (2013) reported a weak correlation between disability and neck movements. The participants in that study had low fear of movement related to pain (fear avoidance). Thus, their function was not affected to the extent that it caused disability. Also, limitation in cervical range of movements due to neck pain is common among workers who spend an average of 95% of their working time sitting in a prolonged forward head posture (Ariëns et al. 2001; Cagnie et al. 2007). This situation was not applicable in our study as the majority of our participants were retirees.

Range of movement limitation leading to disability is more common among individuals with acute musculoskeletal conditions (Malik et al. 2017). Adults with chronic neck pain at primary healthcare receiving physiotherapy treatment have been noted to be high functioning and to have adjusted to their pain (Hout et al. 2001). According to the neurophysiological ‘pain adaptation’ model, musculoskeletal injuries and pain lead to decreased activity of agonist muscle and increased activity of antagonist muscle (Nederhand et al. 2006). Such changes in the motor function occur as an adaptation strategy to prevent pain during movements
in the acute and chronic stages of musculoskeletal pain conditions.

It is noteworthy that our study was limited to a small sample in a clinical setting where the majority of the participants were older adults aged 60 and above. Hence, our study results may not be generalized to other heterogeneous groups with chronic neck pain. It is recommended that future studies should involve a larger number of participants with chronic neck pain from different age groups, occupation and from more clinical sites. Studies comparing adults with acute and chronic NSNP may also be helpful in providing specifically tailored intervention for these groups.

CONCLUSION

The results from our study indicate that improved muscle strength reduces disability among adults with chronic neck pain. It is important for physiotherapists to promote strengthening exercises among adults with chronic neck pain for optimum health.

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