Med & Health Dec 2018; 13(2): 122-132 https://doi.org/10.17576/MH.2018.1302.12

ORIGINAL ARTICLE

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

PONVEL P[1], SINGH DEVINDER KA[1], YAN HANG M[1], MUNIANDY Y[2], MOKHTAR S[3]

[1]Program of Physiotherapy, Centre for Rehabilitation and Special Needs, Faculty of Health Sciences, University Kebangsaan Malaysia; Jalan Raja Muda Aziz, 50300, Kuala Lumpur, Malaysia.

[2]Faculty of Health and Life Sciences, INTI International University, Nilai, 71800 Negeri Sembilan, Malaysia

[3]Department of Orthopedic and Traumatology, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia.

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 in. 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/m^2), kini menganggur dan mengalami sakit leher yang teruk (Skor Penilaian Numerikal >7). Kekuatan tangan adalah satu-satunya

Address for correspondence and reprint requests: Devinder Kaur Ajit Singh. Program of Physiotherapy, Centre for Rehabilitation and Special Needs, Faculty of Health Sciences, University Kebangsaan Malaysia, Jalan Raja Muda Aziz, 50300, Kuala Lumpur, Malaysia. Tel: +603-26810203 Email: devinder@ukm.edu.my

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/m^2), 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 (Rudolfsson 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

Table 1: Socio-demographic details, NDI score, GHQ-28 score, cervical range of motion and handgrip strength of participants

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	9	26.5		
	>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	15	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

Table 2: Relationship between dominant handgrip strength with neck disability among adults with non- specific neck pain.

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

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 at 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.

2003).

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.

ACKNOWLEDGEMENT

The authors would like to thank all participants and staff from Orthopedic Clinic and Physiotherapy Department of Hospital Chancellor Tuanku Muhriz Universiti Kebangsaan Malaysia for their time and support.

REFERENCES

Audette, I., Dumas, J.-P., Côté, J.N., De Serres, S.J. 2010. Validity and between-day reliability of the cervical range of motion (CROM) Device. *J Orthop Sports Phys Ther* **40**(5): 318–23.

Ariëns, G.A.M., Bongers, P.M., Douwes, M., Miedema, M.C., Hoogendoorn, W.E., van der Wal, G., Bouter, L.M. et al. 2001. Are neck flexion, neck rotation, and sitting at work risk factors for neck pain? Results of a prospective cohort study. *Occup Environ Med* **58(**3): 200-7.

Bellace, J.V., Healy, D., Besser, M.P., Byron, T., Hohman, L. 2000. Validity of the Dexter Evaluation System's Jamar dynamometer attachment for assessment of hand grip strength in a normal population. *J Hand Ther* **13**(1): 46-51.

Bohannon, R.W. 1998. Alternatives for measuring knee extension strength of the elderly at home. *Clin Rehabil* **12:** 434-40.

Bohannon, R.W., Peolsson, A., Massy-Westropp, N., Desrosiers, J., Bear-Lehman, J. 2006. Reference values for adult grip strength measured with a Jamar dynamometer: a descriptive meta-analysis. *Physiotherapy* **92**(1): 11-5.

Binder, A. 2007. The diagnosis and treatment of nonspecific neck pain and whiplash. *Eura Medicophys 43*(1): 79-89.

Briggs, A.M., Straker, L.M., Bear, N.L., Smith, A.J. 2009. Neck/shoulder pain in adolescents is not related to the level or nature of self-reported physical activity or type of sedentary activity in an Australian pregnancy cohort. *BMC Musculoskelet Disord* **10**: 87-97

Cagnie, B., Danneels, L., Van Tiggelen, D., De Loose, V., Cambier, D. 2007. Individual and work related risk factors for neck pain among office workers: A cross sectional study. *Eur Spine J 16*(5): 679-86

Chan, O.Y.A., van Houwelingen, A.H., Gussekloo, J., Blom, J.W., den Elzen, W.P.J. 2014. Comparison of quadriceps strength and handgrip strength in their association with health outcomes in older adults in primary care. *Age* **36**(5): 9714-76.

Childs, J.D., Piva, S.R., Fritz, J.M. 2016. Responsiveness of the numeric pain rating scale in patients with low back pain responsiveness of the numeric pain rating scale in patients with low back pain. *Spine* **30**(11): 1331-4.

Chiu, T.T.W., Lam, T., Hedley, A.J. 2004. A randomized controlled trial on the efficacy of exercise for patients with chronic neck pain. *Spine* **30**(1): 1–7.

Chiu, T.T., Leung, A.S. 2006. Neck pain in Hong Kong: a telephone survey on prevalence, consequences, and risk groups. *Spine (Phila Pa 1976)* **31**(16): E540-4.

Cheung, J., Kajaks, T., Macdermid, J.C. 2013. The relationship between neck pain and physical activity. *Open Orthop J* **7**(1): 521-9.

Chodzko-Zajko, W.J., Proctor, D.N., Fiatarone Singh, M.A., Minson, C.T., Nigg, C.R., Salem, G.J., Skinner, J.S. 2009. Exercise and physical activity for older adults. *Med Sci Sports Exerc* **41**(7): 1510-30.

Gustavsson, C., Bergström, J., Denison, E., Von Koch, L. 2013. Predictive factors for disability outcome at twenty weeks and two years following a pain self-management group intervention in patients with persistent neck pain in primary health care. *J Rehabil Med* **45**(2): 170-6.

Downie, W.W., Leatham, P.A., Rhind, V.M., Wright, V., Branco, J.A., Anderson, J.A. 1978. Studies with pain rating scales. *Ann Rheum Dis* **37**(4): 378-81.

Farooq, M. N., Mohseni-Bandpei, M. A., Gilani, S. A., Ashfaq, M. & Mahmood, Q. 2018. The effects of neck mobilization in patients with chronic neck pain: A randomized controlled trial. *J Bodyw Mov Ther* **22**(1): 24-31.

Fejer, R., Hartvigsen, J. 2008. Neck pain and disability due to neck pain: What is the relation? *Eur Spine J* **17**(1): 80-8.

Felício, D.C., Diz, J.B.M., Pereira, D.S., Queiroz, B.Z., Silva, J.P., Moreira, B.S., Oliveira, V.C., Pereira, L.S.M. 2017. Handgrip strength is associated with, but poorly predicts, disability in older women with acute low back pain: A 12-month follow-up study. *Maturitas* **104**: 19-23.

Ferraz, M.B., Quaresma, M.R., Aquino, L.R., Atra, E., Tugwell, P., Goldsmith, C.H. 1990. Reliability of pain scales in the assessment of literate and illiterate patients with rheumatoid arthritis. *J Rheumatol* **17**(8): 1022-4.

Fried, L., Tangen, C., Walston, J., Newman, A., Hirsch, C., Gottdiener, J., Seeman, T., Tracy, R., Kop, W. J., Burke, G., McBurnie, M.A. 2001. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* **56**(3): M146-56.

Genebra, C.V.D.S., Maciel, N.M., Bento, T.P. F., Simeão, S.F.A.P., Vitta, A. De. 2017. Prevalence and factors associated with neck pain: a population-based study. *Braz J Phys Ther* **21**(4): 274-80.

Gross, A.R., Goldsmith, C., Hoving, J.L., Haines, T., Peloso, P., Aker, P., Myers, C. 2007. Conservative management of mechanical neck disorders: a systematic review. *J Rheumatol* **34**(5): 1083-102.

Hardy, S., Grogan, S. 2009. Preventing disability through exercise: Investigating older adults' influences and motivations to engage in physical activity. *J Health Psychol* **14**(7): 1036–46.

Hjermstad, M.J., Fayers, P.M., Haugen, D.F., Caraceni, A., Hanks, G.W., Loge, J.H., Fainsinger, R., Aass, N., Kaasa, S. 2011. Studies comparing numerical rating scales, verbal rating scales, and visual analogue scales for assessment of pain intensity in adults: A systematic literature review. *J Pain Symptom Manage* **41**(6): 1073-93.

Howell, E.R. 2011. The association between neck pain, the Neck Disability Index and cervical ranges of motion: a narrative review. *J Can Chiropr Assoc* **55**(3): 211-21.

Hout, J.H.C. Van Den, Vlaeyen, J.W.S., Heuts, P.H.T.G., Sillen, W.J.T., Willen, A.J.E.H.L. 2001. Functional disability in nonspecific low back pain: the role of pain-related fear and problem-solving skills. *Int J Behav Med* **8**(2): 134-48.

Hoy, D.G., Protani, M., De, R., Buchbinder, R. 2010. The epidemiology of neck pain. *Best Pract Res Clin Rheumatol* **24**(6): 783-92.

International Occupational Therapy. 2002. Comparison of Rolyan and Jamar dynamometers for measuring grip strength **9**(3): 201-9.

Johnston, V. 2016. Consequences and management of neck pain by female office workers: results of a survey and clinical assessment. *Archives of Physiotherapy* **6**(1): 8.

Kay, T. M., Gross, A., Goldsmith, C.H., Rutherford, S., Voth, S., Hoving, J.L., Brønfort, G., Santaguida, P.L. 2015. Exercises for mechanical neck disorders. *Cochrane Database Syst Rev* (8): N.PAG.

Kumbhare, D.A., Balsor, B., Parkinson, W.L., Harding Bsckin, P., Bedard, M., Papaioannou, A., Adachi, J.D. 2005. Measurement of cervical flexor endurance following whiplash. *Disabil and Rehabil* **27**(14): 801-7.

Kumar, N.S.S., Daniel, C.R., Hilda, M., Dharmarajan, R. 2012. Grip strength: influence of head-neck position in normal subjects. *J Neurol Res* **2**(3): 93-8.

Langley, P., Müller-Schwefe, G., Nicolaou, A., Liedgens, H., Pergolizzi, J., Varrassi, G. 2010. The impact of pain on labor force participation, absenteeism and presenteeism in the European Union. *J Med Econ* **13**(4): 662-72.

Lenardt, M.H., Carneiro, N.H.K., Betiolli, S.E., Binotto, M.A., Ribeiro, D.K. de M.N., Teixeira, F.F.R. 2016. Factors associated with decreased hand grip strength in the elderly. *Escola Anna Nery - Revista de Enfermagem* **20**(4): 1–7.

Lindstrøm, R., Schomacher, J., Farina, D., Rechter, L., Falla, D. 2011. Association between neck muscle coactivation, pain, and strength in women with neck pain. *Man Ther* **16**(1): 80-6.

Malik, A.A., Robinson, S., Khan, W.S., Dillon, B., Lovell, M.E. 2017. Assessment of range of movement, pain and disability following a whiplash injury. *Open Orthop J* **11**(1): 541-5.

Mäntyselkä, P., Kautiainen, H., Vanhala, M. 2010. Prevalence of neck pain in subjects with metabolic syndrome-a cross-sectional population-based study. *BMC Musculoskelet Dis* **11**: *171-176.*

Mitsionis, G., Pakos, E.E., Stafilas, K.S., Paschos, N., Papakostas, T., Beris, A.E. 2009. Normative data on hand grip strength in a Greek adult population. *Intl Orthop* **33**(3): 713-7.

Mustafa, Y., Sutan, R. 2013. Work related neck pain and its associated factors among registered female nurses who are computer users in Universiti Kebangsaan Malaysia Medical Centre. *J Nurs Health Sci* **1**(2): 41–56.

Nederhand, M.J., Hermens, H.J., Ijzerman, M.J., Groothuis, K.G.M., Turk, D.C. 2006. The effect of fear of movement on muscle activation in posttraumatic neck pain disability. *Clin J Pain*, **22**(6): 519–25.

Nilsen, T.I., Holtermann, A., Mork, P. J. 2011. Physical exercise, body mass index, and risk of chronic pain in the low back and neck/shoulders: longitudinal data from the Nord-Trondelag Health Study. *Am J Epidemiol* **174**(3): 267-73.

Nikander, R., Mlki, E., Parkkari, J., Heinonen, A., Starck, H., Ylinen, J. 2006. Dose-response relationship of specific training to reduce chronic neck pain and disability. *Med Sci Sports Exerc* **38**(12): 2068-74.

Peolsson, A., Hedlund, R., Birgitta, O. 2001. Intra- and inter-tester reliability and reference values for hand strength. *J Rehabili Med* **33**(1): 36-41.

Philadelphia Panel Evidence-Based Clinical Practice Guidelines. 2001. Philadelphia Panel Evidence-Based Clinical Practice Guidelines on for Neck Pain. *Phys Ther* **81**(10): 1701-17.

Piva, S.R., Erhard, R.E., Childs, J.D., Browder, D. A. 2006. Inter-tester reliability of passive intervertebral and active movements of the cervical spine. *Man Ther* **11**(4): 321-30.

Pool, J.J.M., Ostelo, R.W.J. G., Hoving, J.L., Bouter, L.M., de Vet, H.C.W. 2007. Minimal clinically important change of the neck disability index and the numerical rating scale for patients with neck pain. *Spine* **32**(26): 3047-51.

Rezai, M., Côté, P., Cassidy, J.D., Carroll, L. 2009. The association between prevalent neck pain and health-related quality of life: a cross-sectional analysis. *Euro Spine J* **18**(3): 371-81.

Rudolfsson, T., Björklund, M., Djupsjöbacka, M. 2012. Range of motion in the upper and lower cervical spine in people with chronic neck pain. *Man Ther* **17**(1): 53-9.

Serlin, R.C., Mendoza, T.R., Nakamura, Y., Edwards, K.R., Cleeland, C.S. 1995. When is cancer pain mild, moderate or severe? Grading pain severity by its interference with function. *Pain* **61**(2): 277-84.

Sturgeon, J.A., Taub, C.J. 2016. Pain Resilience: Issues of Modeling Dynamic Adaptation in Chronic Pain. *Escritos de Psicología / Psychological Writings* **9**(3): 15-27.

Taekema, D.G., Gussekloo, J., Maier, A.B., Westendorp, R.G.J., de Craen, A.J.M. 2010. Handgrip strength as a predictor of functional, psychological and social health. A prospective population-based study among the oldest old. *Age Ageing* **39**(3): 331-7.

Tousignant, M., Smeesters, C., Breton, A.-M., Breton, É., Corriveau, H. 2006. Criterion validity study of the cervical range of motion (CROM) device for rotational range of motion on healthy adults. *J Orthop Sports Phys Ther* **36**(4): 242-8.

Tsang, S.M.H., Szeto, G.P.Y., Lee, R.Y.W. 2014. Altered spinal kinematics and muscle recruitment pattern of the cervical and thoracic spine in people with chronic neck pain during functional task. *J Electromyogr and Kinesiol* **24**(1): 104-13.

Veerapen, K., Wigley, R.D., Valkenburg, H. 2007. Musculoskeletal pain in Malaysia: a COPCORD survey. *J Rheumatol* **34**(1): 207-13.

Verhagen, A.P., Karels, C., Bierma-Zeinstra, S.M. A., Feleus, A., Dahaghin, S., Burdorf, A., Koes, B.W. 2007. Exercise proves effective in a systematic review of work-related complaints of the arm, neck, or shoulder. *J Clin Epidemiol* **60**(2): 110-7.

Vernon, H. 2008. The neck disability index: State-of-the-Art, 1991-2008. *J Manipulative Physiol Thera* **31**(7): 491-502.

Werle, S., Goldhahn, J., Drerup, S., Simmen, B.R., Sprott, H., Herren, D.B. 2009. Age- and gender-specific normative data of grip and pinch strength in a healthy adult Swiss population. *J Hand Surg Eur Vol* **34**(1): 76-84.

Yip, C.H.T., Chiu, T.T.W., Poon, A.T.K. 2008. The relationship between head posture and severity and disability of patients with neck pain. *Man Ther* **13**(2): 148-54.

Ylinen, J.J., Savolainen, S., Airaksinen, O., Kautiainen, H., Salo, P. 2003. Decreased strength and mobility in patients after anterior cervical discectomy compared with healthy subjects. *Arch Phys Med Rehabil* **84**(7): 1043-7.

Young, B.A., Walker, M.J., Strunce, J.B., Boyles, R.E., Whitman, J.M., Childs, J.D. 2009. Responsiveness of the Neck Disability Index in patients with mechanical neck disorders. *Spine Journal* **9**(10): 802-8.

Received: 23 May 2018
Accepted: 15 Oct 2018