Cross cultural validation of ND10-H and prevalence of neck pain in workers using computers in India

Cross cultural validation of ND10-H and prevalence of neck pain in workers using computers in India

By

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Cross cultural validation of ND10-H and prevalence of neck pain in workers using computers in India

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This thesis is dedicated to my Guru Swami Brahmananda my spiritual inspiration; and my parents; thank you for the guidance and the unconditional love, my fuel to keep going.

CONTRIBUTIONS:

The body of this thesis consists of two separate papers, each formatted according to the requirements of the journal to which they will be submitted. Hiten Thakker designed the study, recruited subjects, completed the data collection, analyzed the data, wrote the draft manuscript and made revisions. JC MacDermid developed the ND10, supervised the research design and analysis and contributed to revisions. J Busse and A Gross provided input into the research design, analysis and revisions to the manuscript.

ABSTRACT

Neck pain is the second most common musculoskeletal disorder after low back pain adding to the global burden of disease. A focus on evaluating outcomes for musculoskeletal conditions is imperative to evaluate the effect of interventions and to track the progression of disease. As evidence based practice and associated use of patient-based outcomes are taken up across different countries, it becomes imperative for cross-cultural translation studies. Given the uptake of technology in workplaces, it is also important to understand the prevalence of neck pain in this context. This thesis has focused on two objectives:

1. Translating a newly developed patient-report outcome measure of neck-related disability and testing its psychometric properties.
2. Estimating the prevalence of neck pain in computer-using workers.

The first manuscript focusses on cross cultural translation and validation of ND10 (Neck difficulty10) that was designed to measure neck-related disability. A new English outcome measure for neck disability (ND10) was cross culturally translated and validated in computer users in India using forward and backward translation, and cognitive interviewing to determine a final version. The ND10-H demonstrated high reliability (ICC= 0.93) and convergent construct validity with the NDI and DASH (r= 0.78 and 0.86)

The second manuscript reported the prevalence of neck pain in computer users in India. Sampling was performed in two different companies: A Spiritual Media Publication Organization (SMPO) and an Information Technology (IT) company. The companies were selected based on computer use and their willingness to participate. The survey was administered to all employees (n=150 & n=54) at these two companies. The overall prevalence of neck pain was 64%. In the IT company, 78% of employees reported neck pain; and in the SMPO the prevalence was 40%. There were no significant differences in prevalence based on gender or age. All of the IT company computer users worked more than seven hours at their computers, while 38% of the SMPO workers did so. Chronic pain was present in 48%of the total sample.

The ND10-H can be used to assess neck-related disability in Hindi-speaking individuals. It should be accompanied by a valid pain measure when assessing patient outcomes. The prevalence of neck pain is high in computer-using workers in India.

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LIST OF ABBREVIATIONS

CEO: Chief Executive Officer

COSMIN: COnsensus-based Standards for the Selection of health Measurement Instruments

DASH: Disability of Arm Shoulder Hand

HR: Human Resource

IT: Information Technology

ICF: International Classification of Functioning

ICC: Intra Class Coefficient

KTA: Knowledge To Action cycle

LOA: Limits Of Agreement

ND10: Neck Difficulty 10

ND10-H: Neck Difficulty 10 Hindi

NDI: Neck Disability Index

OLBPD: Oswestry Low Back Pain Disability Index

PRO: Patient Reported Outcome measure

QoL-SIG: Quality of Life Special Interest Group

SMPO: Spiritual Media Publication Organization

SANE: Single Assessment Numeric Evaluation

SES: Socio Economic Status

TCA: Translation and Cultural Adaptation

CHAPTER 1: INTRODUCTION

Musculoskeletal disorders and computer work

Computers became a household item in the late 1980s (1) and since then a common tool of everyday life and work. As computer-related work becomes more prevalent, it has an overall impact on health and wellness. Health, as defined by World Health Organization (WHO), is "a complete state of physical, psychological and social well-being and not a mere absence of disease or infirmity." Prevalence studies are used to estimate the number of people who are affected by a specific condition or problem. Prevalence studies focus on estimating the existing proportion the population that are affected by a specific condition or problem. Differences in point prevalence estimates across studies can identify factors associated with a problem that may inform research or policies to address the problem. Many factors, such as computer use, contribute to the prevalence of musculoskeletal disorders Symptoms in the neck, shoulder, elbow, wrist and hand have been associated with computer use (2,3).

Epidemiological evidence can inform jurisdictions to monitor and pass regulations to control exposure to adverse biomechanical factors at work (4). Surveillance data for incidence and prevalence have been reported from disability insurance schemes, labour protection authorities (1,4–9), self-reported morbidity (10,11) representative samples and clinical health surveillance (11,12). Estimates may vary based on the source of data. Musculoskeletal disorders in developed countries account for a cost of $500 million per year (13).

The aetiology of musculoskeletal diseases is complex, definitions or diagnostic criteria are often unclear and multiple conditions may co-exist, making it difficult to establish prevalence estimates. Although, the relationship between some risk factors and these health conditions have been established (14,15), there are many factors that are still unexplored. Low back pain and neck pain are the most common musculoskeletal disorders (16,17). The global incidence of low back pain is 36% (18) and neck pain ranges from 10.4 to 21.3% with a higher incidence in office and computer workers (19). Low back pain and neck pain are an important area of research and interest due to the economic and social burden of disease and disability.

Neck pain and its impact

Neck pain is a common cause of disability throughout the world (19) and causes loss of pay and absenteeism (5,8,11,20). In the nation as a whole, neck pain leads to an increase in insurance claims and disability claims (6,21). It has also been established that neck pain and disability have a negative impact on overall health-related quality of life, and persistent neck pain has a more negative impact on health and quality of life (22). There is significant heterogeneity in the design of neck pain prevalence studies (23) throughout the world, making it difficult to compare studies. Furthermore, it may be possible that factors associated with causing neck pain differ based on location of the study. The overall prevalence of neck pain has been reported to vary from 0.4% to 86.6% (mean 23.1%)(19,23–26).

There are some common factors that have been associated with neck pain across different prevalence studies. In computer workers, the use of a mouse (27–29) and visual display units (26,30–41) are associated with neck-related pain and disability. Prevalence estimates may vary based on risk factors or duration of exposure. Computer users have a higher prevalence of neck-related pain and disability compared with the general population (42).

Neck pain, has been defined in numerous ways in the literature. Some studies have shown a diagram explicitly showing the location of the pain (e.g. from the occiput to third thoracic vertebrae), while others have simply asked a self-report understanding of neck pain and have left the location of the neck as an implicit understanding. These differences in how neck pain is defined and how study samples are derived may partially explain the variance in neck pain prevalence across studies.

International collaborative studies such as the Global Burden of Disease Study (19), the Burden and Determinants of Neck Pain Study, (26,43) and other systematic reviews (23,42) have synthesized data on neck pain to provide a more accurate picture of neck-related pain and disability, and to describe potential contributing risk factors. The study on global burden of disease for neck pain concluded that more studies were needed to identify predictors and to describe the clinical course of neck pain in low and middle income countries (44). The study on burden and determinants of neck pain recommended etiological studies to explain risk factors for neck pain and disability (26). Cross-sectional studies are a good starting point for understanding the burden of neck pain; however they need to be followed by cohort and case control studies to identify risk and protective factors associated with neck pain and disability (45). A systematic review on neck pain found significant variation in the design of neck pain prevalence studies and recommended standardization of design methods (23). Another systematic review found that duration of computer and mouse use positively correlated with an increased incidence of neck and hand arm symptoms (42). Furthermore, mouse use correlated more with neck and shoulder symptoms than computer use (42).

Patient-Reported Outcome measures and significance of cross cultural translation studies.

Patient-reported outcome measures (PRO) are tools to get an insight into a patient's condition from a patient-centric perspective (46). There are various types of outcome measures including: impairment based, joint specific, and overall health and quality of life (46). Outcome measures evolved as emphasis on a biopsychosocial perspective of health evolved. When evaluating the effect of a disease process on the individual traditionally, the approach was to focus on the impairment or the diseased part. As research explained that function may be fully related to impairment (47,48) and that quality of life can be improved by improved participation, the approach to treatment changed has evolved(47–49).

PROs can be used as guiding tools by clinicians to focus treatment on patient-oriented issues. PROs can help to redirect the therapist to address the problem areas reported by patients, helping to maintain focus and perspective. Clinical outcomes may improve when patients start taking a more active role in the process of their health by sharing the responsibility of the management of their condition with the health care provider (50). Evidence has shown that use of PROs leads to better communication and a better decision-making process between the doctors and the patients and improves patient satisfaction with care (51–54). Nevertheless, for these measures to report real clinical change they need to undergo a vigorous process of psychometric testing.

Important aspects of psychometric testing for PROs is test-retest reliability and construct validity, as these provide more confidence that the measure provides valid information for clinical decision-making. Validation helps to establish that the measure is representative of constructs that are a part of a single dimension. For example, the SF 36 measures general health and it contains questions related to the overall dimension of health (i.e. questions measuring different constructs like bodily pain, physical role functioning, mental health, emotional role functioning). Cross-cultural translation and validation studies are used to take measures developed in one language and cultural context and determine how they can be used to provide similar information in another language or cultural context. It is imperative that tools that are cross culturally translated measure the same construct and provide similar clinical measurement properties to the original version.

Context and cultural differences may change the way the questions are worded in the questionnaire without changing the construct intended to be measured. For example, driving may not be culturally relevant for females in some countries, like the United Arab Emirates, but it could be replaced by transportation, which maintains the construct integrity and makes the question culturally relevant. Cross-cultural translation studies go beyond translation of the language contained in individual items to consider how the concept might differ in different cultural contexts. There is a systematic process involved to develop a cross culturally translated PRO's. This is important for countries having a high report of the burden of disease (55,56) and low funding for research (57) since many of the tools are developed in English-speaking countries with greater resources for tool development. The best way to meet the need in developing and underdeveloped countries is by culturally adapting developed and established measures in a contextually relevant format. For this purpose, there are established methodological processes (58,59) to maintain the process as systematic, testable and valid. In addition, cross-cultural translation studies add to the body of clinical measurement evidence that supports the original measure because they provide insight into the psychometric performance of the measure in a different ethno-cultural group than the original, and add information about variation in outcomes data across different contexts.

Evidence based physiotherapy and its emerging prominence in India.

The Indian subcontinent is a part of South-East Asia that is quite far removed from the original development of evidence-based practice. The use of patient reported outcome measures as a part of evidence based practice is well established in developed countries as seen in the rise of the quality of life measures across the spectrum of diseases and population (60). Evidence based practice is defined as "conscientious, explicit, judicious use of current best evidence in making decisions about the care of individual patient or client" (61).

The Knowledge to Action (KTA) model (62,63) would be an ideal way to visualize the process of moving from evidence to practice. In the center is knowledge synthesis; physiotherapy in India is slowly catching up with the rest of the world with systematic reviews (64) and randomized control trial (RCTs) (65,66) being published in international journals. Improvements in the quality of research published by researchers in India on physiotherapy research questions indicates the emerging awareness of the importance of scientific rigor in clinical observations (65). The part lacking through the process of implementing evidence-based practice is adequate ways to measure the outcome of an intervention using PROs. A survey asking the use of outcome measures in India reported that 85% of the respondents used outcome measures in practice, but, most were using outdated impairment-based measures (67). The survey reported a need for newer standardized culturally relevant outcome measures for uptake in this region (67).

Thesis rationale and objective

Given the need for culturally relevant and standardized outcome measures (67), it is important that cross-cultural translation studies be conducted rigorously. The Neck Difficulty 10 (ND10) was recently developed by Dr. MacDermid and colleagues to assess the construct of neck related functional disability. It is a 10 item questionnaire. It retains some constructs that are similar to the NDI but unlike the NDI, does not include symptom questions and does address upper extremity disability related to neck pain. Thus, 2 questions address overhead activities (68) and carrying (68), both established as impaired in neck disability; and none of the questions specifically addressed neck pain as that was not considered the construct to be measured by this tool. Rather, the tool measures the disability consequences of neck pain.

There is a paucity of studies in India reporting prevalence of neck pain in computer workers. Understanding the global burden of illness for different conditions is important and requires studies in different countries and in different contexts. Given the emergence of computer-based work in India and prior research suggesting an association between computer use and neck pain it was important to describe the prevalence of neck pain and computer users working in companies in India. Thus, based on these necessities, the objective of this thesis work to:

1) Conduct a cross-cultural translation of the neck difficulty 10 (ND-10) in Hindi (ND10-H); and determine the clinical measurement properties of the translated tool.
2) Estimate the prevalence of neck pain and related-disability in computer professionals in India.

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CHAPTER 2: STUDY ONE

CROSS CULTURAL TRANSLATION AND VALIDATION OF THE Neck Difficulty 10 (ND10) IN HINDI

Cross-cultural translation and validation of the Neck Difficulty10 (ND10) in Hindi

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Abstract

Study Design: Cross-cultural translation and validation study

Objective: To cross-culturally translate the Neck Difficulty10 (ND10) to the Hindi language (ND10-H) and evaluate its psychometric properties.

Background: The ND10 was developed to measure function in patients with neck pain. It is available in English only, which limits its use among individuals in India.

Methods: The ND10 was cross-culturally translated to a Hindi version (ND10-H) using forward translation, backward translation and cognitive debriefing. We administered the ND10-H to employees of two companies in India, an Information Technology (IT) company and a Spiritual Media Publication Organization (SMPO), and explored internal and test-retest reliability, and convergent validity. We also assessed the respondents' overall preference between the ND10-H, the Neck Disability Index (NDI), and the Disability of Arm Shoulder Hand (DASH).

Results: Our survey was completed by 107 computer workers, for a response rate of 52% (107 of 204). The ND10-H displayed very high internal consistency (alpha = 0.96) and test-retest reliability (ICC = 0.93; 95% CI: 0.90-0.95). The ND10-H was strongly correlated with the NDI (r = 0.78; 95% CI: 0.68-0.85) and the DASH (r = 0.86; 95% CI: 0.74-0.92), and was weakly correlated with the Single Assessment Numeric Evaluation (r = -0.23; 95% CI: 0.01-0.42). Respondents reported no preference between the ND10-H, NDI, or DASH.

Conclusion: The ND10-H is a valid and reliable tool that can be used to measure neck-related function in Hindi-speaking patients with neck pain.

Background

The neck is one of the common areas affected by musculoskeletal pain with a global mean point prevalence that varies from 5 (1) to 14% (3). The course of neck pain is episodic and may progress to develop chronic symptoms. The mean six-month prevalence of neck pain among adults is 30% and in adolescents varies from 6% to 45% (2). The use of patient reported outcome (PRO) measures has become fundamental for evaluation of neck pain related disability, as they facilitate patient communication and collaborative setting of treatment goals (4).

The Neck Disability Index (NDI) is the most commonly used PRO for neck related disability (5). An international survey identified that 65% of physiotherapists, 46% of chiropractors and 27% of physicians use the NDI to assess disability among patients with neck pain (6). Despite the frequent use of the NDI, concerns about its measurement properties have been raised. Rasch analysis indicates that the NDI does not have interval level scaling and its items do not fit a single construct (6, 7). A systematic review of the NDI found that it has high reliability but its factor structure is controversial (9). While some studies have found one factor (7,8) which would support a single total score, others have suggested that two or more subscales may exist (8,9,10).

The need for a PRO that would focus solely on neck related disability as a single construct motivated the construction of the original English version of the ND10. Given the strong history of measuring symptoms and disability using the NDI, one of the principles of construction was retention of some of the concepts of the NDI, while adding two extra items (6 and 12 of DASH) for placing objects on a high shelf and overhead activities. These additional items were developed through qualitative interviews with patients, expert informants and analysis of problematic items on an upper extremity measure (12,13). The ND10 was constructed with consistent responses in a table with a goal of reducing both response burden and literacy demands.

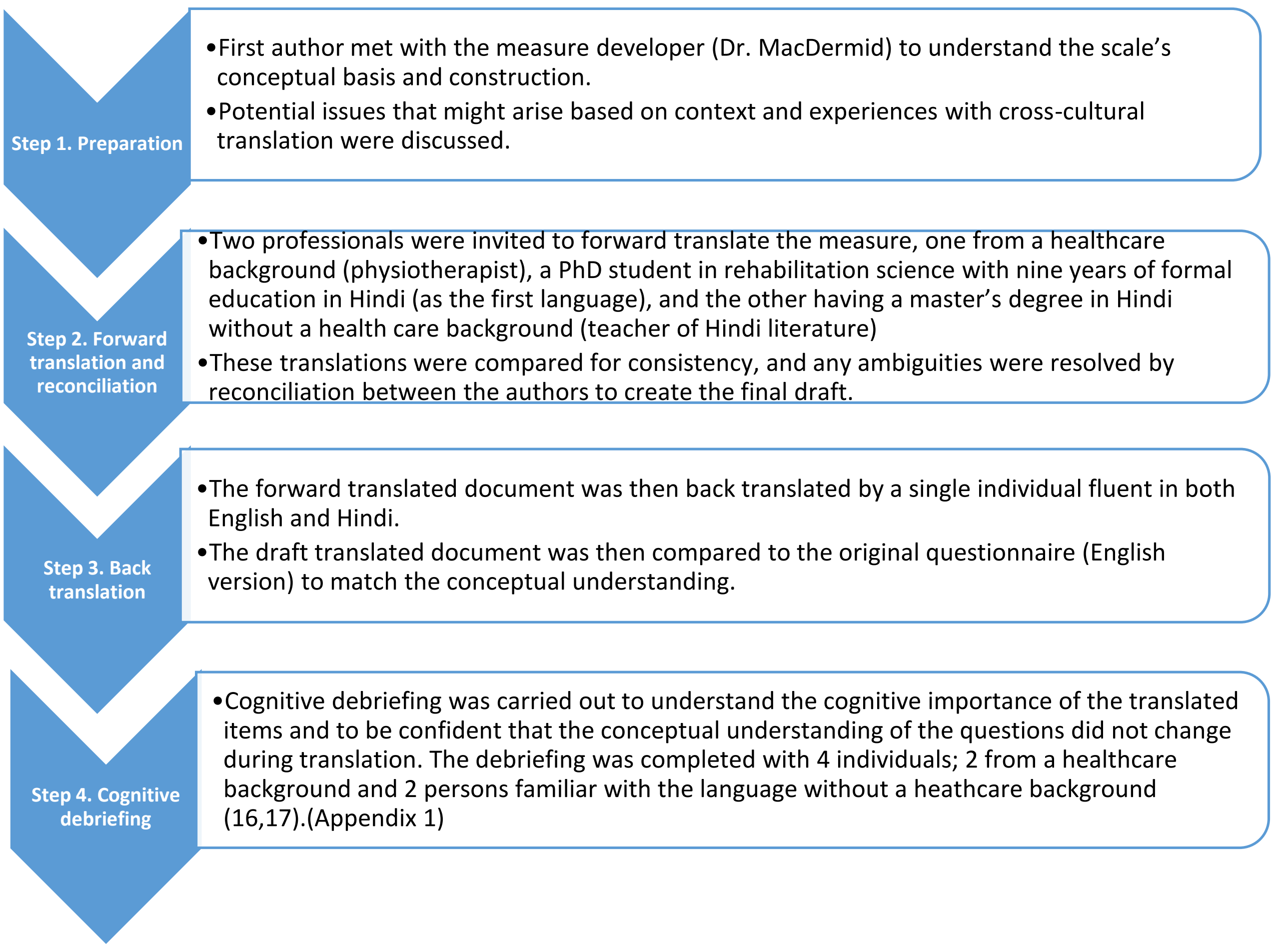
Hindi is a national language of India and is spoken by over 400 million of its inhabitants (14). Translating the ND10 into Hindi would facilitate administration in India, and to Hindi-speaking patients living elsewhere. Our primary objective was to translate the ND10 into Hindi and assess its psychometric properties. Our secondary objective was to evaluate respondents' overall preference between the ND10-H, the NDI, and the Disability of Arm Shoulder Hand (DASH).

Methods

Phase 1. Cross cultural translation.

We carried out the translation of Hindi version of ND10 using methodology proposed by the Quality of Life Special Interest Group (15), detailed in Figure 1.

Figure 1. Flow chart of the development of Hindi version of the ND10



Phase 2. Psychometric properties evaluation process

Sites

We administered the survey to two groups of computer workers (n=150 & n=54) at two different computer user firms in India. The companies were selected based on computer use and their willingness to participate. At the first company, a manager sent out our survey to all 150 employees by email, whereas at the other company (HT) was able to approach the 54 staff members in person to complete an email survey.

Sample size calculations

Based on the consensus-based standards for the selection of health measurement instruments checklist of rating methodological quality of measurement studies, we considered a sample size of 50 to 100 to be sufficient for reliability studies (16). We also calculated (Appendix 2) the sample size for reliability using power predicted for the Intraclass Correlation (ICC) (17). We set the lowest acceptable ICC at 0.70 (18). The predicted ICC was 0.90, as this has been previously reported for the NDI (19). The required sample size for the reliability analysis using these values was 19. Since precision of correlations is improved with greater sample size, larger sample sizes were required for construct validity.

Outcome measures

All the outcome measures were in English except the translated ND10-H.

Neck Difficulty10-Hindi (ND10-H)

The ND10 is a 10-item questionnaire (Appendix 3) that measures function in individuals with neck pain. It was designed to have uniform and simple response options. The ND10 quantifies function on a six-point ordinal scale, anchored with zero representing 'no difficulty' at one end and five representing 'unable to do activity' at the other. The total score of the questionnaire is out of 100 where higher scores indicate greater disability. The scores are calculated as total score/50*(multiply)100. The ND10-H is the Hindi version of this measure (Appendix 4).

Neck Disability Index (NDI)

The NDI (Appendix 5) is a 10-item self-administered questionnaire that measures neck-related pain and disability (20). This instrument has shown high test-retest reliability (ICC=0.90-0.93) and internal consistency (Cronbach's alpha range from 0.74 to 0.93) (5).

Disability of Arm Shoulder Hand (DASH)

The DASH (Appendix 6) is a 30 item self-reported upper limb related questionnaire that evaluates symptoms and physical function of the arm, shoulder and hand with five response options for each item (21). A higher score indicates greater disability. The test-retest reliability of DASH has been reported to be ICC=0.96 (22).

Single Assessment Numeric Evaluation (SANE)

The SANE is a single item used to measure overall function that has been validated for shoulder (23–26). An individual is asked to rate the score between zero and 100 where a higher score indicates better functional ability, with zero being no function and 100 being normal function.

Questionnaire Administration

In February 2014, we administered the ND10-H, NDI, SANE questionnaires and a demographic questionnaire (i.e. age, gender, and current status of neck pain) to all 204 employees from the IT company and the SMPO. We also administered the DASH and the preference survey to all 54 employees of the 2nd firm (SMPO). The management of the IT firm would not allow administration of the DASH or preference questionnaires due to their concerns about the burden of responding and demands on employee time. We administered the ND10-H to all 204 employees seven days after the initial completion to determine test-retest reliability.

Data analysis

Our quantitative data analysis used the SPSS software version 20. We set the level of significance at $p < 0.05$. Demographics were collected from the participants and descriptive statistics were calculated for all the outcome measures and medians were reported (as the data was skewed). Homogeneity (internal consistency) of the measure (27) was determined using Cronbach's alpha with acceptability indicated by $\alpha > 0.70$ (28). Test-retest reliability of the ND10-H was calculated by calculating the ICC (2.1) (29) and associated confidence intervals. The ICC values can range from zero to one: 0-0.2 indicates poor agreement, 0.3-0.4 indicates fair agreement, 0.5-0.6 indicates moderate agreement, 0.7-0.8 indicates strong agreement, and >0.8 indicates almost perfect agreement (29) .

We used the Bland and Altman plotting (30) technique to analyze the agreement between the test and re-test scores of ND10-H between the first and second occasion. This method gives a graphical representation of retest differences plotted against the mean score (31). This technique allows for examination of potential biases across test occasions i.e. either consistently rating it higher or lower.

The individuals were asked, "Are you currently suffering from neck pain?" This question was used to determine known group validity by differentiating those who had neck pain and those who did not have neck pain using the Mann-Whitney U Test. Preference for measures was documented by asking the respondents to rate which of the three questionnaires (NDI, ND10-H, DASH) was easy to read, easy to answer, most relevant and most preferred. Cronbach's alpha calculated internal consistency and was reported for ND10-H.

We examined convergent validity by assessing the relationships between ND10-H, NDI, DASH and SANE using Pearson's correlation coefficients (r) (18). The r values describe the degree of correlation between the measures where 0 = no correlation and 1 or -1 = a perfect correlation. We categorized Pearson's correlations as follows: 0.00 to 0.19 = very weak correlation; 0.20 to 0.39 = weak correlation; 0.40 to 0.69 = moderate correlation; 0.70 to 0.89 = strong correlation and 0.90 to 0.1 = very strong correlation (32). Based on the literature review, (33) (12) (34) the following hypotheses were formed for the measure to test the psychometrics of ND10-H.

Hypotheses

1) Since both the ND10-H and NDI focus on function among patients with neck pain and also share 8 similar items, it was hypothesized that the correlation between ND10-H and NDI would be strong r >0.70 (33).
2) It was hypothesized that the correlation of ND10-H and DASH would be strong r>0.70, as neck pain and upper extremity disability often occur together, and the DASH has been shown to have items that are salient in a neck pain population (12).
3) Since the SANE is a single global item that measures function and the ND10-H is a 10-item disability scale, it was hypothesized that ND10-H and NDI would negatively correlate with SANE (low to moderate correlation).
4) For known group validity, it was hypothesized that both the ND10-H and the NDI would be able to discriminate (34) between individuals with neck pain and individuals without neck pain.

We evaluated respondent preferences using the Chi-square test for the following criteria: 1. easy to read, 2. most relevant, 3. easy to answer, and 4. most preferred.

Results

Phase 1 Cross cultural translation with cognitive debriefing

Comprehensibility and questions redesigning

Most of the respondents in our cognitive interviews found the ND10-H easy to read. Traditional and orthodox words were elaborated by explaining the meaning in brackets. Grammatical corrections suggested by our forward translating team were incorporated. The questions were made applicable to both the genders by adding gender specific terminology.

During the translation process:

1) Some modern words were not literally translated into Hindi because the common practice has become to use the actual English word e.g. computer, car, bus, bulb.
2) Certain semantics were changed to suit the local context.

Respondent feedback and decision processes

During our interviews, respondents found the questionnaire easy to read and answer, as they correctly identified the meaning of items and found all of the items relevant. The suggestions to add questions on stress and pain radiating to the hand were not advisable as neither pain nor stress were within the conceptual framework of the ND10. When given a forced choice, our respondents found the ND10-H to be more relevant than the NDI and DASH. Although 48% found the ND10-H easiest to read compared to 26% choosing the NDI or DASH, this was not statistically significant. For ease of answering or overall preference neither clinical nor statistical significance differences were observed.

Characteristics of Respondents

We approached 204 computer workers and asked them to complete the ND10-H, NDI and SANE, and 54 computer workers were asked to complete the DASH and the preference survey. Response rates were 74% for the DASH (40 of 54), 70% for the preference survey (38 of 54), 52% for the NDI (107 of 204) and the SANE (105 of 204), and 41% for the ND10-H (84 of 204). Gender was equally distributed among respondents and 65% were in the age group of 18-35 (Table 1).

Consistent with a low overall level of disability, scores were skewed towards the right for scores for the ND10-H, NDI and DASH and toward higher function scores for the SANE.

Table 1. Respondent characteristics and descriptive statistics of the outcome measures

Categories		Group 1: Frequency for IT professionals
Age	**18-35**	55
	36-65	12
Gender	**Males**	30
	Females	37
Neck pain status	**Yes**	52
	No	15
Questionnaire (n)	**Median scores for the questionnaires**	**Inter-Quartile Ranges**
NDI (107)	17	13-24
DASH (40)	15	11-19
ND10-H (84)	6	1-11
SANE (105)	80	60-95

IQR-Interquartile range; M=Median; NDI= neck disability index; DASH = disability arm shoulder hand; ND10-H = neck difficulty 10 Hindi; n= number of individuals

Table 2. Chi Square test for preference survey

Factors	ND10-H n (%)	NDI n (%)	DASH n (%)	X^2	p-value
Easy to read	18 (48)	10 (26)	10 (26)	3.36	0.18
Easy to answer	13 (34)	14 (37)	11 (29)	0.36	0.83

Most relevant	**20 (52)**	11 (30)	7 (18)	7.00	**0.03**
Preferred	12 (31)	14 (37)	12 (31)	0.21	0.90

NDI= neck disability index; DASH = disability arm shoulder hand; ND10-H= neck difficulty 10 Hindi; n= number of individuals
n=no of respondents, X^{2}=chi square value

Phase 2: The psychometric testing phase
Reliability

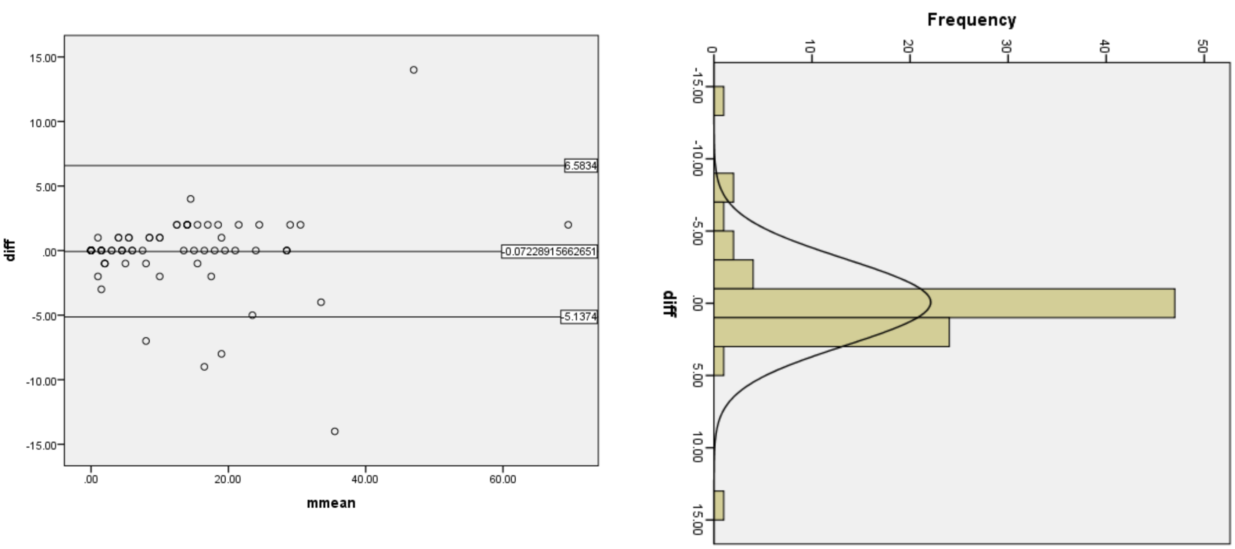


Figure 2. The agreement between the ND10-H scores on first and second assessment sessions is shown in this figure **mean** of **ND10-H** (both occasions) and **diff** is the difference of **ND10-H** between first and second occasion. The lines for limits of agreement and mean difference are illustrated on the plot. Histogram of difference between first and second occasion is on the left. Zero difference between occasions occurred in almost half of the respondents

We note that the ND10-H exhibited very high internal consistency shown by Cronbach's alpha value of 0.96 (n = 66) (Table 3). The test-retest reliability of the ND10-H demonstrated almost perfect reliability [ICC = 0.93; 95%CI: 0.90–0.95] (Table 3). The Bland and Altman plots (Figure 2 and Figure 3) indicated that we had no bias between the two occasions as the mean difference (MD) with n = 83 (MD = 0.07, SD = 2.99). The LOA (limits of agreement) upper limits were +6.58 and lower limit were -5.13. The Bland and Altman plots (without individuals scoring zero on test-retest reliability) (Figure 3) and scores in individuals with neck difficulty were MD = 0.03, SD = 3.50 with n = 66. The LOA upper limits were +5.86 and lower limit were -6.89.

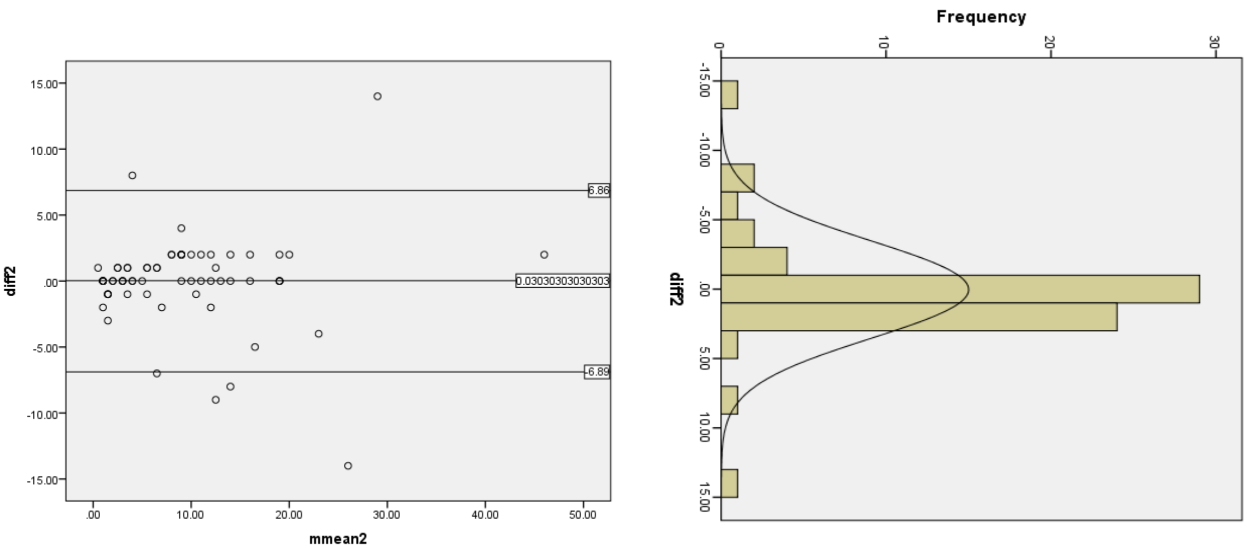


Figure 3. The agreement between the **ND10-H** scores on 1st and the 2nd assessment sessions is shown in this figure. **Mean2** is the mean of **ND10-H (**both occasions) without individuals scoring 0 on the first and second occasion. **diff2** is the difference of **ND10-H** between 1st and second occasion. The lines for limits of agreement and mean difference are illustrated on the plot. Histogram of difference between 1st and 2nd occasion is on the left. As suggested by Bland and Altman the errors follow a normal distribution(35).

Convergent Validity

We note the correlations between the ND10-H, NDI, DASH and SANE in Table 3. The highest correlation was observed between the ND10-H and DASH (r = 0.86; 95%CI: 0.74-0.92). The ND10-H showed a strong correlation with the NDI (r = 0.78; 95%CI: 0.68-0.85). The DASH and NDI showed moderate correlations with each other (r = 0.61; 95%CI: 0.36-0.77). Weak negative correlations were found between SANE and either the ND10-H (r = -0.23; 95%CI: 0.01-0.42) and the NDI (r = -0.34; 95%CI: 0.15-0.49).

Table 3. Reliability and Convergent Validity Correlations

Reliability and Internal Consistency of ND10-H	**n**	**ICC (95% Cl)**	**95% CI**
ND10-H	66	0.93	(0.90-0.95)
ND10-H internal consistency	84	Alpha-0.96	
Convergent Validity; Correlation between measures	**n**	**Pearson's coefficient**	**95% CI**
ND10-H & DASH	38	0.86	(0.74-0.92)
ND10-H & NDI	84	0.78	(0.68-0.85)
DASH & NDI	40	0.61	(0.36-0.77)
SANE & NDI	105	-0.34	(0.15-0.49)
SANE & ND10-H	84	-0.23	(0.01-0.42)

Known Group Validity

Our findings demonstrate that the NDI, ND10-H, and SANE were able to discriminate individuals with neck pain (and individuals without neck pain) (Table 4). The DASH was not able to discriminate between individuals with neck pain (mean rank = 54.54) and individuals without neck pain (mean rank = 53.50) at Z (1289) = -0.240, p = 0.81, although the sample size was smaller for this analysis.

Table 4. Known group validity (ND10-H) for individuals with and without neck pain

Outcome Measures	**Neck Pain**	**n**	**Mean rank**	**p value**
NDI	yes	68	64	**0.001**
	no	39	37	
DASH	yes	16	55	0.81
	no	24	54	
ND10-H	yes	52	60	**0.009**
	no	32	44	
SANE	yes	66	44	**0.001**
	no	39	68	

SD = standard deviation; NDI= neck disability index; DASH = disability arm shoulder hand; ND10 Hindi = neck difficulty 10 Hindi; n= number of individuals. Level of significance at p < 0.05. * significant results; + = non-significant results

Discussion

We were successful in cross-culturally translating the ND10-H into Hindi using an accepted translation process (16). This resulted in a measure of neck-related disability that was well accepted by Hindi-speaking patients and that demonstrated strong measurement properties. One issue encountered during our translation process was potential conflicts between traditional orthodox Hindi versus modern Hindi. We choose the latter because it was more relevant in modern day usage. This highlights that languages and cultures are not static, and items and translations may need to be revisited over time as languages adapt and evolve over time. Since the ND10-H refers to reading as occurring in multiple formats, i.e. print or electronic, whereas the NDI refer to reading a book, this reflects that both items and translation demands are not static.

We validated the ND10-H in a population of individuals who worked for long hours in front of a desktop computer and where the expected prevalence of neck pain would be comparatively higher (36-48%) (15,37) than the average adult population (5.9-22.2%) (1). This mixed sample of people with and without neck pain allowed us to test for known group validity. Further, since the DASH was not in the Hindi version, the fact that computer users were comfortable with English allowed us to assess convergent construct validity with the DASH. However, a downside to this approach is that we did not test the ND10-H on people who only spoke Hindi. Since English is taught in schools in India, more educated individuals would be comfortable with both languages.

The Neck Pain and Disability Scale (37) and the Neck Disability Index (38) have now both been translated from their English versions. This reflects an emerging interest for PROs in India. The availability of a Hindi version of different PRO may allow for assessment of subsets of the Indian population that are not fluent in English. However, most health care providers continue to use clinician-based signs and patient reported symptoms for measuring the change in the status of health (37). With the emergence of cross-cultural validations, clinicians can now change their practice patterns from impairment focused practice to include more functional outcomes.

The ND10-H had high internal consistency (0.96) and test-retest reliability (0.93, 95%CI: 0.90-0.95), and this narrow confidence interval (0.90-0.95) suggests that we can be confident in the resulting scores. The ND10-H point estimates (correlation values) were slightly higher with the DASH than NDI (see Table 3). This is consistent with our expectations since the DASH has been validated for people with neck pain and focuses on function, whereas the NDI has symptom questions that rate neck pain and headache. Further, one of the items added to the ND10 based on interviews with people with neck pain was difficulty with overhead activities and reaching activities (12,13). These items place more emphasis on neck and upper limb functioning as a unit. Since the NDI development did not include patient interviews in item generation and did not contain these items, this may explain why ND10-H correlations with the DASH were slightly higher than NDI. However, the correlations were not statistically different from each other. The main finding was that both the NDI and DASH have high correlations with ND10-H. This is consistent with their similar focus on neck related function.

The negative correlation between the SANE and ND10-H (see Table 3) was consistent with the fact that the SANE indicates overall function, whereas the ND10-H measures disability. Given that a single item might have greater measurement error and because the SANE requires a global assessment of function, we did not expect high correlations. The correlations between the SANE and either the NDI or ND10-H were similar, suggesting they performed similarly. We attribute the lower correlations with SANE to differences in the number of items (one versus multiple), types of ratings (global versus standardized items) and perspective (ability to do rating versus percentage of normal). This suggests that the SANE measures a different construct than the ND10, DASH or NDI and raises concern about whether it can substitute for use of these standardized item measures. A single item like the SANE may be a useful adjunct to the ND10, NDI or DASH, but further research may be needed to determine what it actually measures.

The ND10-H and NDI (see Table 4) were both able to discriminate between individuals with neck pain and without neck pain even though the level of disability was not high in this working population. The DASH was not able to discriminate between individuals with neck pain and persons without neck pain. We believe this may have been due to two factors, the smaller sample size and because it was administered only at the SMPO site where the prevalence of neck pain was lower. Further, the DASH might be more likely to pick up upper extremity problems not related to neck pain. Since we had less neck pain and less power in DASH respondents, it would be premature to question its ability to discriminate neck pain. However, given that computer users are susceptible to upper extremity problems we speculate that it is also possible that the DASH is less discriminative for neck pain in this patient population. While we would have preferred to administer the DASH to all participants, this was not allowed at one site. Research within occupational settings is challenging, and particularly so in India where awareness of the importance of research is emerging. We accredit the better access and use of a longer survey that included the DASH at the SMPO to the fact that the CEO was a physiotherapist who was educated in Australia and understood the need and purpose for this research.

More respondents found the ND10-H to be the most relevant of the PRO provided (see Table 2). Although almost half also found it the easiest to read, this was not significant in comparison to the 26% who selected either the NDI or DASH. This reflects the low power we had in this comparison, since only a subset of our sample responded to these questions. We noted that there were no clear overall preferences for ease of answering or overall preference. A major issue with this comparison is that only the ND10-H was in Hindi and thus language preferences may have been a confounder in our comparisons. Since all respondents worked in English and had mandatory requirements for reading, writing, listening and speaking skills in English this may have affected how they responded to these questions.

It was not our purpose to investigate the NDI, as this has been performed in a series of previous studies and summarized in a systematic review (19). While much supporting evidence has been published for the NDI, other researchers have suggested concerns about the factor structure, the appropriateness of some items and lack of interval scaling as described in the introduction. Two studies have tried to address limitations in the scaling of the NDI using Rasch analysis (39,40). These studies have relied on item reduction to achieve a smaller set of either five or eight-items that were able to provide interval level scaling. The “research solutions” for the NDI have not agreed with each other, gained widespread usage nor been improved by the developer. Further, Rasch can rehabilitate items by rescoring, or deleting items but these approaches do not identify or resolve critical missing concepts. Similarly, the ability of the ND10 to withstand a Rasch analysis is unknown. We believe this is an important future research question, as is the issue of responsiveness.

In developing the ND10, MacDermid tried to retain some legacy concepts from the NDI while adding key missed content drawn from qualitative and empirical studies. Individuals with neck pain may have symptoms radiating to the hand or the arm. These are important aspects to capture. This may be why the DASH performs well in people with neck pain (12). Hence, items on the ND10 that related to lifting and carrying or overhead work may tap into relevant constructs not assessed by the NDI. However, pain is an important construct and should be measured with a valid but separate tool when designing a measurement strategy for patients with neck pain.

One item that has a high rate of omittance on the NDI has been driving. This is likely because many people do not drive. This may be both a source of both cultural or gender bias. This is important in an Indian context as many people would not drive a motor vehicle. Nevertheless, transportation challenges are common in the presence of spinal pain. Thus, “long rides/driving” allows for different types of transportation and being a passenger rather than a driver, and for different modes of transportation, and should include a greater spectrum of people. This is an example of how the considering contexts other than first world countries when constructing a measure might facilitate the cross-cultural translation process.

Limitations

Our study provides preliminary support for the ND10-H, but must be considered in conjunction with our study limitations. The questionnaire of ND10 was administered in Hindi while other questionnaires—DASH, NDI and SANE—were administered in English. This may have led to a bias in the responses as there might have been a preference for a particular language while responding to the questions. This reduces the generalizability of the results to older and less well-educated individuals. Another limitation is that our preference survey was only administered at the SMPO and hence was underpowered. Other limitations included the smaller sample size for DASH analyses which might have reduced the power for known group validity.

Conclusion

The ND10-H is a reliable and valid measure of neck pain, can discriminate office workers with/without neck pain, and is strongly related to the DASH and NDI. Studies on longitudinal validity, Rasch analysis, responsiveness and factor structure are needed before the value of the ND10 can be determined.

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CHAPTER 3: STUDY TWO

Prevalence of neck pain and related-disability in computer professionals in India

Prevalence of neck pain and related-disability in computer professionals in India

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Abstract

Study Design: Cross sectional prevalence study

Objective: To describe the point prevalence and age/gender specific rates of subacute and chronic neck pain in two companies in India where workers used computers for a majority of their work tasks.

Background: Neck pain is the fourth leading cause of disability with an overall prevalence rate of 0.4-41.5% (mean 14.4%). India is the second largest global population with 1.2 billion people, but the prevalence of neck pain and related disability in working professionals in India is unknown.

Methods: A survey containing the NDI (Neck Disability Index) questions on chronicity of pain, hours of work in front of the computer, current neck pain status and demographic questionnaires was distributed to all employees at two computer user organizations: An Information Technology (IT) company and a Spiritual Media Publication Organization (SMPO). Neck pain was defined as present if the employees answered positively to the question "Do you currently suffer from neck pain?" The extent of the neck or upper extremity related disability was determined by using the NDI classification of mild (5-14), moderate (15-24), and severe neck pain (25-34). Differences in the prevalence of neck pain and risk based on age group or gender were tested using Chi-square. The literature on prevalence of neck pain in computer users was summarized and tabulated. A single evaluator read all titles and abstracts to determine eligibility. Data was extracted from each study with respect to the prevalence of neck pain (n=103).

Results: In this study, 204 participants were given surveys, and from that 107 people responded (52% overall response rate; 74% SMPO response rate; 44% IT company response rate). The sample consisted of 52% males and 48% females; 66% were ≥35 and 44% were <35years old. The level of computer users who reported current neck pain was 64%, and 62% if based on a positive response to the pain question of the NDI (40% SMPO; 76% IT company). The majority of workers in the SMPO (62.5%) and all of the workers in the IT company used computers more than 7 hours/day. Chronic pain was present in 48% of the employees and neck pain > 3 months was present in 15% of employees, whereas 36% reported no current neck pain. There was no difference in prevalence based on gender (Males-54%: Females-45%; X^2 (1) =0.68: p > 0.68) or age (≤ 35-69%: >35-30%; X^2 (1) =0.27: p > 0.27). The literature reviews of neck pain in computer users indicated that prevalence varied from 12 to 55.6% and suggested that neck pain may be more common than the normal population across different studies.

Conclusion: The prevalence of neck pain in computer users in India is high and suggests the need to identify predictors of neck pain beyond basic demographics, and develop appropriate prevention strategies.

Prevalence of neck pain and related-disability in computer professionals in India

Background

Accurate prevalence estimates identify the burden of illness and how it changes based on policies and programs (8, 9), and may assist with funding allocation. Neck pain (NP) is the forth-leading cause of disability in the US (1). In Canada neck and shoulder pain constitute 25% of reported repetitive stress injuries (5) with a lifetime prevalence of 0.4–41.5% (median 14.4%) (2). The annual prevalence of neck pain varies widely from 4.8–79.5% (median 25.8%) (2). About half of people who experience neck pain have recurrent neck pain after receiving treatment (1). From a public health perspective, neck pain adds to the economic (3), social (5) and psychological (5) burden of the community, causing loss of income and work productivity. In Canada, the estimated cost of musculoskeletal disorders (MSKD) is $20 billion (6).

Computer work has been associated with greater neck related disability and dysfunction (1–3). In India, computer work is common in many different companies. However, little is known about the prevalence and severity of neck pain in Indian computer workers. In India, we expect culture, English literacy and work environments might be different than that of other countries where neck pain has been studied. Work culture may vary due to the nature of the industry, work environment, social norms, cultural differences or other factors. In India, the language and culture may change every 100 kilometers (19). Organizations draw their workforce locally; hence the local culture will be reflected in the workforce, as work culture is deeply rooted in societal culture (19).

The purpose of this study is to describe the point prevalence and age- and gender-specific rate of subacute and chronic neck pain in two companies in India where workers used computers for the majority of tasks. A secondary purpose was to compare point prevalence estimates in this study with those previously reported in the literature for the general population and computer workers.

Methods

Ethics approval was obtained from the McMaster Students Ethics Board.

Sites and participants

The first site was an IT company that had employees working on the computer for a minimum of 7 hours/day. The IT company had 150 employees at the site where the survey was administered. The human resource (HR) manager was the point of contact at the IT company. The second site was a Spiritual Media Publication Organization (SMPO) that had 54 employees with duties that included accounting, office administration, marketing, graphic designer, systems engineering, and data management. The CEO of SMPO was the point of contact for the organization. The survey was sent to all employees at both companies.

Definition of neck pain and survey outcome measures

The point prevalence of neck pain was determined by asking the question “Do you currently suffer from neck pain?” The point prevalence was calculated for the total sample (n=107) as our primary indicator, but site rates were reported to examine site variations.

Pain that persists for more than three months is defined as chronic pain (27). Hence, respondents were asked if they had neck pain for more or less than three months. The Neck Disability Index (NDI) (4–6) was used to quantify the severity of neck pain and disability and was administered in English. The NDI has been widely validated and translated (6). Each item in the NDI is scored from 0–5, for a maximum overall score of 50; higher scores equate to greater disability. The interpretation of the disability is reflected by the scores as follows: 0–4=none; 5–14=mild; 15–24=moderate; 25–34=severe; and over 34=complete (6). The test retest reliability is 0.90–0.93 and Cronbach's alpha is 0.74–0.93 (6).

Survey administration

The surveys were mounted in Survey Monkey for electronic administration. At the SMPO, the survey data was collected directly by the first author. The survey was hosted by the local server at the IT company and the data was transferred to the first author. A cross-sectional survey was emailed to all 204 employees from both companies in early February. Recruitment strategies were designed in collaboration with HR from the respective organizations. At both sites, demographics, NDI, current neck pain status, hours working in front of a desktop computer and chronicity of neck pain questions were asked. The survey took 15–20 min to complete. These questionnaires were administered once with a three-day follow-up reminder.

There was a request for an information session on neck pain from the IT company. Therefore, an information session was provided to both sites after completion of data collection. At the SMPO, the first author provided a group information session to facilitate the survey. At the IT company, the survey was emailed with a notice. During the recruitment presentation, the employees were not informed about how to answer or rate the questions in the survey.

Methods for literature review

For the second objective, a search strategy was designed to identify papers neck pain prevalence. The search strategy is described in Appendix 7. Papers were included for data extraction if they reported primary data on point prevalence of neck pain in normal or computer-using samples. A single evaluator read all titles and abstracts to determine eligibility for the literature review. Data was extracted from sample and included with respect to the prevalence of neck pain in computer workers from 103 articles 13 were selected.

Data analysis

Descriptive statistics was used to summarize data. The chi-square test was calculated for gender and age difference in prevalence of neck pain.

Results

From the total of 204 employees, 107 responded to the questionnaire (Table1), for an overall response rate of 52%. From these respondents, 66% were ≥35 years old and 44% were <35 years old (Table 1). From the 150 employees at the IT company, 67 responded (response rate of 44%). At the SMPO, 40/54 employees participated in the survey (response rate of 74%). The gender distribution was 52% men and 48% women (Table 1). At the IT company, all employees worked more than seven hours/day and at the SMPO, only 63% worked more than seven hours/day. The overall combined prevalence of neck pain was 64% (68/107) based on the question "Do you currently suffer from neck pain?" (Table 2). Of the individuals with neck pain, 48% suffered from neck pain for more than three months and 15% reported that they suffered for less than three months. Based on the pain subscale of the NDI, 62% (66/107) reported neck pain and 38% reported no neck pain (Table 2). Of the 107 respondents, 41 (38%) reported mild neck disability, 48 (44%) reported moderate neck disability and 18 (17%) reported severe neck disability (Table 3). The chi-square test did not indicate significant differences in pain prevalence based on gender (male-54%: females-45%; X^2 (1) =0.68: p > 0.68) and age (≤ 35–69%: >35–30%; X^2 (1) =0.27: p > 0.27). Prevalence of neck pain based on literature review is summarized in Table 4.

Table 1. Descriptive statistics and demographics for both the organizations

Category		**Group 1: IT Frequency**	**Group 2: SMPO Frequency**
Age	**18–35**	55	15
	36–65	12	25
Gender	**Male**	30	26
	Female	37	14
Neck pain status	**Yes**	52	16
	No	15	24
Questionnaire	**Median (M)**	**Inter-quartile range (IQR)**	**Individuals (n)**
NDI	17	13–24	107

IQR-Interquartile range; M=Median; NDI= neck disability index; n= number of individuals

Table 2. Prevalence of neck pain based on NDI score

Neck pain prevalence			**NDI score**	
"Do you currently suffer from neck pain ?"		**Neck pain prevalence based on NDI item on pain**	**Median**	**Inter-quartile range**
No Neck Pain	n=39	n=41	12	10–17
Yes, Neck Pain	n=68	n=66	21.5	16–26

Table 3. Classification of sample based on NDI score

Disability based on NDI score (n=107)	**Median**	**Inter-quartile range** **25th and 75th percentile**	**Neck pain based on the NDI item on pain**
Mild: 5 to 14 = 38%	**12**	**10-17**	**No pain = 38%** **Mild Pain = 22%**
Moderate: 15 to 24 = 45% **Severe: 25 to 34 = 17%**	**18** **28**	**15-23** **25-34**	**Moderate pain = 22%** **Severe pain = 17%**

Table 4. Prevalence of neck pain based on different population-based surveys.

References **Prevalence of population neck pain**	**Population and sample**	**Questions asked for point estimate of neck pain**	**Point prevalence** **% (95 CI)**
Chiu (7)	Hong Kong residents who could speak Cantonese (15–99 years old)	Did you have neck pain the last 7 days?	12%
Cote (8)	Residents of Saskatchewan aged 20 to 69	Do you have neck pain at the present time i.e. right now?	22% (19.7–24.7)
D. Hoy et al. (9)	Systematic review of prevalence, incidence, remission, duration and mortality risk of neck pain.	Activity limiting neck pain (pain referred into upper limb(s) that last for at least 1 day.)	4.9% (4.6–5.3)

Prevalence of chronic neck pain	**Sample**	**Questions asked for point estimate of chronic neck pain**	**Prevalence (%)**
Cassou (10)	Longitudinal study with random sample of males and females. (88% contacted and 87% interviewed again after 5 years). 378 subjects were interviewed.	Pain lasting for six months or more	7.8% men and 14.8% women
Anderson (11)	Random sample of two communities: Bromolia and Simrishamn, Sweden	Do you suffer from pain lasting more than 3 months?	16%
Michelle (12)	Computer users in a large manufacturing company. Cross sectional survey.	During last 3 months' neck discomfort.	43%
Computer use and point prevalence of neck pain	**Sample**	**Questions asked for point estimate of neck pain**	**Prevalence %**
Jensen (13)	11 Danish companies with 5033 computer workers (response rate of 77%)	Symptom of neck pain for 1–7 days in the last year	44.7%
Brandt LPA (14)	9480 technical assistants and machine technicians in the Danish association of professional technicians.	Neck pain during last 7 days.	36%
Talwar (15)	200 computer professionals from Delhi and the National Capital Region, including software developers, call center workers, and data entry workers.	Pain and stiffness in the neck	48.6%

Bojana (16)	49 computer workers	Nordic musculoskeletal questionnaire (neck pain in last 7 days)	12.2%
Karin (17)	8000 employees from Australian public services and 6 government departments	Nordic musculoskeletal questionnaire (neck pain in last 7 days)	30%
Valarie (18)	175 UK trade union data processors	Nordic musculoskeletal questionnaire (neck pain in last 7 days)	27%
Kerstin (19)	1459 professional computer users (response rate of 84%).	Self-reported aches and pains in the neck for 3 days or more	45%females 23% males
Marzena (20)	300 workers	Nordic musculoskeletal questionnaire (neck problem yes/no)	34.7%
O Ayanniyi (21)	472 computer users	Standardized Nordic questionnaire (neck symptoms in last 7 days)	33.4%
Jan (22)	477 computers worker's/office employees	Nordic pain questionnaire Polish version (neck symptoms in last 7 days)	55.6%
Inger (23)	148 air traffic controllers (computer users)	Standardized Nordic questionnaire (neck symptoms in last 7 days)	41%
		Nordic pain questionnaire (neck	27%

Jensen (24)	149 computer aided design operators (62% response rate)	symptoms in last 7 days)	
K. T. Palmer (25)	12262 employees including computer workers, analysts, programmers, data processors, clerks, cashiers, book keepers, administrative officers, design engineers, brokers, financial managers, secretaries and typists,	Standardized Nordic questionnaire (neck symptoms in last 1 week)	30%

A systematic search was conducted on PubMed to find articles for neck pain in computer users. 103 articles were found the abstracts were read and articles with point prevalence of neck pain and 3-month prevalence of neck pain were included in the table.

Discussion

This study found a high rate of neck pain among computer using employees in two knowledge-based companies in India. Furthermore, point prevalence of neck pain was similar regardless of whether the point prevalence was determined by a single question on current neck pain status or the pain item from the NDI (point prevalence of 64% and 62%, respectively). The amount of computer use and prevalence of neck pain were higher in the IT group (78% versus 40% at SMPO). It would be presumptive to assume this indicates a dose-response relationship given that our data was cross-sectional; therefore, other factors may have contributed to site differences. Severe neck pain was less common (17%) than mild to moderate pain (45%) based on the NDI pain item.

Disability in this combined sample may have been related to neck pain, but also to other problems, since 38% of those reporting mild neck disability (median 12) also reported no pain on the pain item of the NDI. It is possible this reflects disability from prior neck pain that left residual impairment or a subclinical neck disorder. It is also possible other problems such as upper extremity pain contributed to disability reported on the NDI. There is evidence to suggest that computer use increases upper extremity disability (26) and long hours of computer use, as reported in the IT company, can add to the overall disability experienced by workers (8). Conversely, for the 62% of people who were classified as having neck pain based on the NDI pain item, 38% had mild disability scores (45% moderate and 17% severe). In the literature, sitting during computer use is implicated as a contributor to the disability process. Computer use often involves sitting in a particular position for a long time and doing repetitive movements. It increases the activity of low threshold motor units of trapezius and forearm muscles causing upper extremity disorders (27–29). Although the prevalence of neck pain was high at both sites, there were substantive differences across sites.

While association does not equal causation, the company with the higher level of computer use also had a greater prevalence of neck. There are multiple reasons that may explain the difference in pain prevalence between the two sites. These include the nature of the work, the hours worked, compensation issues, and other unknown factors. At the SMPO, some employees were volunteers due to the religious nature of the work. We do not know how many people were volunteers or whether they were similar to paid employees. Volunteer employees might have more flexible hours and tasks, and might have different attitudes about the work they perform than paid workers. The SMPO also had a broader range of work activities than the IT company, as people performed duties including accounting, office administration, marketing, graphic designer, systems engineer and data management. This variation in tasks may explain the lower point neck pain prevalence observed. A study conducted by computer professionals in Delhi reported a point neck pain prevalence of 49%, which is similar to what we observed within the SMPO (30). There are studies that suggest static postures associated with computer use, especially for a long duration without breaks, are a risk factor for neck-related disability (37,38). On the other hand, the SMPO had employees in different roles with varying levels of computer work, which may contribute to a lower level estimate of point neck pain prevalence. It has been suggested that the incidence of neck disorders is highest in office and computer workers, which may contribute to neck-related disability (33,39–41). This is consistent with the findings of this study

In the IT company, all the employees worked more than 7 hours/day with 52% working 9 hours/day on the computer. While it might be assumed that these differences between the two companies indicate a dose-response, we cannot determine this for a number of reasons. This includes the cross-sectional design and there is potential that other factors may be the underlying reason for the differences observed. For example, the SMPO CEO was a physiotherapist and may have been more aware of preventative factors. Prevalence estimates across sites may have been affected by response bias since the response varied across sites (44% versus 74%). The nature of the tasks performed at the two sites differed- both physically and mentally. The IT company had software engineers doing coding, and this may have been stressful and required long periods of concentration. At SMPO, the duties were more variable and relaxed and when coupled with long working hours may contribute to the overall perception of neck pain. Task studies have reported that increased stress (33), least control over the job (34), increased workplace demand (35,36), and little supervisory support (35,36) are related to neck related disability.

The point prevalence of neck pain varies among population-based surveys and computer users (Table 1). Population-based studies reported neck pain ranging from 6–22% (12,35,42,43) whereas computer users reported prevalence ranging from 12–56% (10-22). The variation in the prevalence of neck pain may be due to a relationship between computer use and neck pain (31). This survey did not document the number or duration of breaks taken by employees, which can reduce the prevalence of neck pain and neck disability (32). It has been reported that the duration of computer use is related to neck and shoulder disorders (33). A systematic review found that the risk of neck pain due to mouse use was greater than for keyboard use or desktop viewing (9). Studies have reported that computer use results in a higher loading of the hand arm region than the neck-shoulder area (24,34,35) .

This study did not find gender-based differences in neck pain prevalence. In the literature, neck pain prevalence has been reported as being higher in women (10–20%) than men (36–38). The majority of the respondents in this study were in the age group 25–35 and thus, if the gender-based differences develop over time, this study may have had too narrow an age range to observe gender differences. Furthermore, there may be differences in work tenure or other unmeasured factors that might have affected gender-related work roles. Collins et al. (37) reported the prevalence of neck pain in women in the age group 35–50 years was 63%, compared with 43% in men. It has been well documented that body size, muscular capacity, hormonal differences, and work life difference may contribute to higher rates of musculoskeletal disorders in females (39,40).

This study did not find any age-based differences in neck pain prevalence. There are studies that suggest age is an important consideration. Studies have indicated that the prevalence of neck pain increases with age and peaks at 35–49 years, after which it begins to decrease (36,41,42). The possible reasons for neck pain in the lower age group include variable years of employment, increased competition at the workplace, and the struggle to succeed (41,43–45). This is characteristic of the initial part of a career where higher stress levels contribute to neck pain (36). There is evidence to suggest that psychosocial factors like stress, lack of support from peers, and high work demands are related to disorders of the upper extremity (44,46). Difference in work expectations and work satisfaction at the two organizations may partially explain differences in the reporting of neck pain. However, these variables were not assessed in this survey. Potential reasons for the lack of age difference include less variability in age in our sample compared to other studies, the classification of age into categories, and the different classification of age across the two sites due to the requirement of using the template of demographics provided by the IT company.

Chronic pain is defined as pain that lasts for more than 3 months or pain that persists even after the usual tissue healing time (47). In this study, 49% of respondents reported having pain for more than 3 months, and 36% reported having no neck pain. The 6-month prevalence of NP varied from 7% (48) to 54% (49) with a mean prevalence of neck pain of 30%. The 3-month prevalence of chronic neck pain as reported by Andersson et al. was 16% (11). We did not collect data on number of years worked in the organization. This information could have given us a clearer understanding of the probable cause of high reporting of chronic pain in this sample.

Study limitations

Prevalence studies are evaluated based on sampling, non-response bias, reliability, and validity of survey instruments (50). In this study, a computer user cohort was used to recruit respondents. The low response rate for the IT company may lead to selection bias compared with the SMPO respondents. Employees without neck pain from the IT company may have elected not to complete the survey, resulting in the overestimation of neck pain prevalence at the IT company. Another limitation of the survey is that we did not ask about the hours of mouse use, keyboard use or display use, as this would give us a better understanding of the risk of neck pain associated with these factors that are known to be associated with neck pain. A detailed employment history would have increased our understanding of the effect of long-term computer work and neck pain. The results of this study cannot be generalized to all companies with computer users in India. This study has a risk of recall bias, which is a threat to validity to any cross-sectional study (51). In recall bias, respondent's answers may depend on their ability to recall and interpret the presence of neck pain, which may influence their answer. This can have an impact on all self-reported variables.

Strengths of this study

This study adds to the literature on neck pain prevalence, and the effect of gender and age differences in neck disability in India. This study identified challenges in the recruitment process at two large organizations. This study showed variation in response rate, and found that follow-up self-management sessions could increase response rate.

Future research implications

Future studies should include more sites, more longitudinal designs and more complete data collection on potential confounders. This data will help determine if there is a causal relationship between computer use and neck pain.

Conclusion

Neck pain may be a common problem among computer users in India, potentially exceeding the prevalence amongst computer users in other countries and exceeding that reported in population-based studies. Given that India is the second largest global population (52) with 1.2 billion people, there may be a substantial need for better primary and secondary prevention to reduce the overall burden. The results of this study are encouraging, and a larger prospective study can be undertaken with a detailed list of factors to better understand variation in neck-related disability in the Indian population.

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CHAPTER 4: DISCUSSION OF THESIS

The goals of this thesis work were to cross-culturally validate a recently developed questionnaire that measures neck-related disability to make it appropriate for use as an outcome instrument in Hindi speaking people (ND10-H), and to use this measure to assess prevalence of neck pain in computer users in India. These two goals were achieved and the findings are highlighted in two manuscripts (Chapters 2 and 3).

In brief, we showed that the ND10-H is a reliable and a valid measure for neck pain as shown by its strong correlation with the NDI (r-0.78) and DASH (r-0.86), which includes measures already valid in neck disability. The prevalence of neck pain as determined at two companies in India was relatively high (64%) compared to the population median, but the median severity of neck pain was moderate (NDI median score=17).

The thesis focused on cross-cultural translation, psychometric testing and validation of ND10-H by comparing it to other neck related disability questionnaires including NDI, DASH and SANE. This thesis adds to the literature by reporting the prevalence of neck pain in computer users in India. The prevalence of neck pain was high in computer users (combined prevalence rate of 64%), but variable between the two companies (IT company-76% and SMPO-40%).

The first study on translation and adaptation demonstrated that the ND10-H is reliable and valid. The ND10-H demonstrates equivalent measurement properties when compared with established measures that are used to assess neck pain and disability. Participants did not show a significant preference for the ND10-H; although this comparison was constrained by the sample size and contaminated by differences in language between compared questionnaires. The participants found the ND10-H relevant but without more detailed study on preferences these findings are very preliminary. Cognitive interviews may be the best way to ascertain how people view differences between these PRO.

The NDI is a popular choice among health care providers internationally, as shown by its numerous translated versions and its use in approximately 300 studies as of 2008 (1). The ND10-H was designed to measure function (not symptoms), but addresses many of the same domains as the NDI. It includes items about overhead activity and raised hand activity based on neck pain input from patients with neck pain and previous studies with DASH, which found that DASH contained salient items related to hand activities that are affected in neck related disability (2).

The Indian context is unexplored in terms of prevalence and musculoskeletal epidemiological studies. This study adds to the growing literature on neck related disability contributing to the burden of disease. Through this study it was discovered that there are prevalence variations in the diverse Indian work environment. Although not significant these results open a discourse on whether there is a preference for English in the working population educated in English or whether these findings would differ if the study were conducted in a rural location with education in Hindi, the official national language. Another important result from the second study (Chapter 3) was that the response rate from the IT company was only 44%. We do not know if this was because of lack of time and work load or due to lack of awareness of research and its implications on health and wellness. We do know that the funding allocated for musculoskeletal conditions and rehabilitation is low (2,3) in India and the burden of the disability is high (4). Considering this, it is possible not much research is conducted in the work sector, making it an unfamiliar concept in this cohort of employees. Addressing this challenging situation, we were able to meet the primary and secondary objectives of the survey.

The majority of this research was conducted in India, which was challenging. It was important, given the nature of the research questions, for the work to be conducted in India. However, the idea of research is new in the corporate world in India and this decreased employees' receptivity to research. A cultural difference in context was evident when we tried to obtain access to workers for the surveys. There was an expectation that the researcher should provide value added service in addition to research activity to gain access. The Human Resource (HR) managers in both companies required workshops and free consultations after the research activity. This added to the workload and responsibilities of the researcher. Importantly, this also may have introduced bias. For example, knowing that workshops on neck pain were scheduled may have made workers more attentive to their symptoms and more likely to report neck pain. If so, estimates of neck pain prevalence would be over-estimated. On the other hand, the pro-activeness of the employees would work well for early identification of symptoms and mitigation of late stage disability. The solutions to this are not clear and may need to be double-pronged. Firstly, researchers may need to be aware that research in India will require different processes involving some value added services to attract HR personnel and employers to be receptive to research initiatives. On the other hand, it would be preferable if employees were more aware of the importance of research and the procedures to protect against bias. This would allow researchers to conduct research free from potential sources of bias. The impact of the access expectations of personnel in the workplace also affected the type or amount of data we were able to collect. The HR manager at the IT company wanted a short questionnaire to be administered. On the other hand, the physiotherapist CEO at the second company allowed the administration of two additional questionnaires. Companies may not want their employees to complete long survey questions because they think it will result in a low response rate or interfere with their workplace productivity. As research gains acceptance in India, these concerns may shift to greater awareness that the respondent should be the one to decide if they want to participate, and that researchers and workplaces should work collaboratively when designing or implementing a study to determine what is feasible and addresses the key research questions, without compromising validity.

The limitation of the first study was that the ND10-H version was in Hindi, whereas other questionnaires were in English and a preference for language may have been a confounding bias. English is a requirement for all professional companies in India and thus English skills were strong for the participants in this study. Unfortunately, we did not anticipate that people might prefer the English version, and we did not assess language preference. This may have contaminated our questionnaire preference results since that opinion may have been more influenced by the language than the questionnaire itself. Language preference is an interesting factor, since cross-cultural translation usually includes both changes for language (Hindi) and cultural context. If people in India are very fluent in English, then the translation to measures in Hindi becomes less important, but the need for cultural equivalence would remain. We think that the fact that we sampled computer technology companies means that the English fluency and educational level were much higher than the general population, meaning that we validated our translation in a non-representative sample but it met the objective of the study of reporting prevalence in computer users in India. Inclusion of lower socioeconomic status (SES) participants in our sample for validation may provide more insights into how the questionnaire was interpreted and could have added more external generalizability to the population. On the other hand, this may have affected our results since SES is related to health outcomes and was not included in the sample. Language preferences and SES should be considered in future cross-cultural translations.

Another limitation of this study was the sample size for DASH, which was limited to 40. This meant our analyses with the DASH were less precise. However, since our prevalence was based on the NDI pain item, this did not affect our prevalence estimates. Variation in neck pain prevalence based on differences between the two work environments is an important consideration. It appears there were differences between the IT company and SMPO which could have influenced sample variability as shown by difference in prevalence estimates at the two sites.

Another methodological limitation of this study was that a one-week period was used to collect data on reliability, and there was no measure used to check if respondents were undergoing any treatment during that period. However, our high ICC value and low mean difference scores as shown by the Bland and Altman graph show a stable test retest measure with less variability, suggesting there was no change in neck function during that period. This period was selected as it is an acceptable time period as reported in literature (5), although a measure administered during the retest occasion would be an accurate way to report a change in neck pain status.

This study concluded that ND10-H was a reliable and valid questionnaire; however, its responsiveness needs to be tested in a longitudinal study. Rasch, factor and responsiveness analyses are required before any overall decisions can be made on the value of this new self-report questionnaire.

Despite the challenges in conducting research in India, it was important to do so. It is a known fact that neck pain is the fourth leading cause of disability in the world and is one of the most common musculoskeletal disorders (6). There have been many epidemiological studies on the prevalence of neck disability in different parts of the world, but few have been in South East Asia, especially India (4). India, being the world’s second most populous country after China, should be considered when prevalence of neck pain is discussed in global forums. The Indian context may exemplify gender-based work roles that are different than many North American work roles and this may affect the prevalence of neck pain. This study found no gender-based differences in neck related disability or prevalence, although in the literature it has been reported that women suffer from greater neck-related pain and disability (7,8), possibly due to unpaid work roles. There were no age-based differences based on prevalence of long-term neck disability. This needs to be considered in the light of sample variance and demographics. The sample consisted of individuals specific to the 25–35 age group, which may have been too narrow to observe age effects.

The reported prevalence of chronic pain in the cohort was high, with 48.5% reporting they had pain for more than 3 months. Factors such as duration of work psychosocial stress and workload may play an important role in maintaining the status of chronic pain (9). The survey found the neck pain prevalence was 76% at the IT company and 40% at SMPO. This may have been due to the fact that the hours of work in front of the computer were higher at the IT company than SMPO. All the employees at the IT company worked for more than 7 hours, whereas only 62% of SMPO employees did. The overall report of neck disability was mild to moderate, possibly because the majority of the employees were in the 18–35 age group. Also, the years of experience in computer work was not documented, which could have been used to determine if a correlation between duration of computer work and neck related disability exists. Other differences included the fact the SMPO CEO was a physiotherapist, which may have led to a more ergonomically compliant work place environment. Although both companies were matched based on similar work setup and computer use, various unaccounted factors may have led to differences between the companies. A limitation that affected both studies was the fact that we only included two sites.

The extent to which they represent the larger sample of companies and computer-using employees is unknown.

The results from the first study suggest that selection of outcome measures for detection or monitoring should consider the constructs of interest, the language and format preferences of the target population, and the psychometric properties. The ND10-H was devised to measure neck-related functional disability, not pain or symptoms, which are separate constructs. Thus the first decision in workplace prevalence studies is whether pain and disability are each constructs of interest. Amongst the measures used in the cross-cultural validation, the SANE is the shortest one-item measure. It was designed to measure how normal a person thinks their function is for a specific target area. It has been previously used for overall functional status of the shoulder after surgery (10–13), but this is the first report of its use in neck pain. SANE might be useful in large workplace screening studies or the general population to document the overall functional status of the neck. However, if the intention was to measure change over time or to identify functional targets, it is likely that multi-item scales like the NDI, DASH, or ND10 would serve better.

This thesis was unable to recommend any of the three tested multi-item scales because other important measurement issues must be evaluated before such decisions can be made. Conceptually, the ND10 is more conceptually clear than the NDI or DASH, as it includes items that were found to be important to patients both from qualitative interviews and from quantitative findings from the DASH (14). There has been much debate about the factor structure of the NDI and the DASH, and separation of symptoms and function is often at the core (15–18). However, the ND10 would have to be used with a pain measure if both concepts are important.

It is important to understand the factors that may contribute to the prevalence of neck pain in office workers so that preventative strategies can be introduced at different levels. Other studies have suggested that demographics such as gender, age and previous history of neck or upper limb disability can add to the prevalence of work-related neck pain (19–22). Environmental factors such as workstation design, task demands, duration of computer use, and frequency of breaks all contribute to neck related disability (23,24). Different postures, including slouched posture and slumped forward posture can contribute to neck related disability (25). Static postures associated with computer use, especially for a long duration without breaks, are a risk factor for neck related disability (25,26). Studies have reported that increased stress increases risk of neck related disability (24), as does low control over the job (27), workplace demand (28,29) and low supervisory support (28,29).

Based on the stated factors, preventative strategies can be introduced for health promotion and wellness in offices. Simple workplace strategies may reduce risk. For example, 30 sec micro breaks have been found to reduce neck related disability (29). Primary prevention also involves overall health promotion (30). This can be achieved by encouraging office workers to engage in physical activity. Companies could invest in fitness areas so that employees can save time by using these facilities during their work day, thereby facilitating a healthy break (29). Other strategies might include educational interventions on micro-breaks, stretching, computer ergonomics and posture. Awareness must be created with the aid of workshops so that more individuals understand the need for exercise and prevention. This can be achieved by a joint corporate-health professional partnership initiative. Business owners and front-line supervisors need to be more aware about the benefits of participating in research and the implementation of best practices from the existing research to promote the health of their employees.

Secondary prevention involves trying to reduce disability by early screening and intervention (30). Regular screening sessions by physiotherapists and healthcare professionals can help prevent further exacerbation. Tertiary prevention measures aim to avoid disability after one is suffering from a disease or pathology (30). Work environment modifications and assistive devices can be used to avoid disability complications. Exercise, especially strength and endurance training, which have shown promising results with women suffering from disability, may be useful for computer users as a means of tertiary prevention (31). Overall, the companies could take an initiative to adopt a proactive role in the health and well-being of their employees; however, it is incumbent on the employee to be an advocate for their personal health and well-being. Only a partnership between the company, employee and health care professionals can promote health and well-being, preventing new incidences or episodes of neck related disability. All of these possibilities could be explored in the context of prevention in workplaces in India. Since much of the research has been conducted in first world countries, the solutions needed for the Indian context may be different. Validated outcome measures are the first step in conducting these needed studies.

A limitation was low the response rate, which could affect the generalizability of the results. The overall response rate was 52% (74% at SMPO and only 44% at IT). It is unclear why was the response rate was higher at SMPO. One explanation is that the CEO of SMPO was a physiotherapist with a research background who may have told employees to complete the survey. Another possibility is that research awareness may have been higher at SMPO, considering the CEO was a physiotherapist. A limitation of this study is that data from the both companies were combined, as the work environments were similar. However, it is impossible to account for all the variation in the groups, and this can affect the generalizability of the results. Care was taken to report the prevalence separately and analyze the possible causes of variation in a site specific manner. Obtaining the best estimate of computer user neck pain prevalence would involve conducting the study at many companies to determine what estimate is more typical and what is an outlier. Furthermore, companies would allow for exploration of predictors of prevalence. Knowledge translation strategies in the corporate world can create awareness, act as catalysts to promote health, and provide an opportunity to the employees to take charge of their health. However, more factors need to be incorporated in the survey questionnaire to better understand the Indian work context in light of emerging evidence. More large-scale studies need to be done to confirm our findings.

Conclusion

The ND10-H is a valid measure of neck-related disability and neck pain is common and often persistent in computer using workers. However, the neck pain generally is associated with a mild level of disability. The prevalence of neck pain suggests a need for better primary and secondary prevention measures.

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Appendix 1

Think aloud

Here the interviewer asks the question and the respondent thinks aloud and answers the interviewer. The respondent is instructed to talk though each understanding of the item and the process the respondent is undergoing while answering it.

Questions

Retrospective probes were used:

E.g. For Comprehension-Can you repeat the question in your own words? Was it hard or easy to answer?

Recall of information/for recall Strategies-How do you remember this?

Terminology Understanding-What do specific terms mean to you?

Confidence Probe-How sure are you of the answer? Each question will have space for comments and suggested revision.

The questions were:

1) What is this question asking?
   - Is it clear?
   - Is it relevant?
2) What do the responses and choices mean to you?
   - Do the responses identify with your problem?

3) How did you choose your answer?

4) Do you think important issues are covered related to your neck problem?

5) If not, what issues do you feel need to be included?

6) Do you have suggestions to improve the questionnaire?

Appendix 2

Sample Size Calculation

$$Zrexpected = .5\text{naturallog}\frac{1 + (2-1)0.90}{1-0.90}$$

ZExpected =1.472

Rlowerlimit=0.7$Zrnull = .5\text{naturallog}\frac{1+(2-1)0.70}{1-0.70}$

Zrnull=0.866

Z value associated with 1 tailed αvalue of 0.05 =1.645

Z value associated with 1 tailed β value of 0.20=0.842

$$n = \frac{0.5\text{k}(\text{Z}\alpha+\text{Z}\beta)^2}{\partial^2(k-1)}+2$$

$$n = \frac{0.5(2)(1.645+0.842)^2}{(1.472-0.866)^2(2-1)}+2$$

N=18.85=19

Appendix 3

Neck Difficulty -10

We want to understand how much difficulty you have because of your neck. Please place an X in the box that best describes your difficulty over the past week for each of the questions below.

Name: ____ Date: _____________________

	No difficulty	A little difficulty	Moderate difficulty	A lot of difficulty	Extreme difficulty	Unable to do at all
Do my personal care (washing, dressing etc.)						
Lift and carry heavy objects						
Read (a book, electronic device etc.)						
Do my usual work (or role)						
Long drives in a motor vehicle (car, bus etc.)						
Do my usual recreation						
Concentrate on tasks						
Sleep in my usual position						
Place an object on a high shelf						

Do overhead work - (like change light bulbs, painting/washing walls)						
Item Score	0	1	2	3	4	5
Column Totals						
Comments				Total Score		

 Item scores range from no difficulty (0) to unable (5). The Total Difficulty Score (X/100) is computed as the sum of the 10 items/50 X 2 to give a score out of 100; or the score can be computed % of the answered items out of 100 (when item(s) missing). E.g. when 1 item missing sum/45 X 100%.

Appendix 4

गरदन कठिनाई 10

हम यह समझना चाहते है कि आपको अपनी गरदन के तकलीफ के कारण कितनी परेशानी है. कृपया x का चिन्ह कोष्टक मे दिये गये हर प्रश्न के लिए लगाए, जो आपकी परेशानी को समुचित (सबसे अछे) तरीके से विवरण करता है

	कोई परेशानी नही	बहुत कम परेशानी होती है	मध्यम परेशानी होती है	बहुत ज्यादा परेशानी होती है	अत्यधिक परेशानी होती है	परेशानी के कारण किसी भी तरह का कार्य नही कर सकते
1) मै स्वयं अपनी देखभाल करता/ करती हूँ(कपड़े धोना पहनना इत्यादि)						
2) भारी वजन उठाना और ले जाना						
3) पढ़ना (एक किताब, कंप्यूटर)						
4) मैं अपना साधारण कार्ये या						

भूमिका कर सकता हूँ						
5) मोटर गाड़ी मैँ लंबा सफर (कार ,बस इत्यादि)						
6) अपना सामान्य मनोरंजन कर सकता/सकती हूँ						
7) अपने कार्यों पर ध्यान केंद्रित कर सकता/सकती हूँ						
8) अपनी सामान्य अवस्था मैँ सो सकता /सकती हूँ						
9) ऊँचे स्थान पर कोई वस्तु रखना						
10) सिर ऊँचा करके कार्य करना (बल्ब बदलना, दीवारों पे रंग लगाना , दीवारों की पुताई करना)						

Appendix 5

Neck Disability Index

THIS QUESTIONNAIRE IS DESIGNED TO HELP US BETTER UNDERSTAND HOW YOUR **NECK PAIN** AFFECTS YOUR ABILITY TO MANAGE EVERYDAY-LIFE ACTIVITIES. PLEASE MARK IN EACH SECTION THE **ONE BOX** THAT APPLIES TO YOU.

ALTHOUGH YOU MAY CONSIDER THAT TWO OF THE STATEMENTS IN ANY ONE SECTION RELATE TO YOU, PLEASE MARK THE BOX THAT **MOST CLOSELY** DESCRIBES YOUR PRESENT-DAY SITUATION.

☐ SECTION 1 - PAIN INTENSITY

- ☐ **I have no neck pain at the moment.**
- ☐ **The pain is very mild at the moment.**
- ☐ **The pain is moderate at the moment.**
- ☐ **The pain is fairly severe at the moment.**
- ☐ **The pain is very severe at the moment.**
- ☐ **The pain is the worst imaginable at the moment.**

SECTION 2 - PERSONAL CARE

- ☐ **I can look after myself normally without causing extra neck pain.**
- ☐ **I can look after myself normally, but it causes extra neck pain.**
- ☐ **It is painful to look after myself, and I am slow and careful**
- ☐ **I need some help but manage most of my personal care.**
- ☐ **I need help every day in most aspects of self-care.**
- ☐ **I do not get dressed. I wash with difficulty and stay in bed.**

SECTION 3 – LIFTING

- ☐ **I can lift heavy weights without causing extra neck pain.**
- ☐ **I can lift heavy weights, but it gives me extra neck pain.**
- ☐ **Neck pain prevents me from lifting heavy weights off the floor but I can manage if items are conveniently positioned, i.e. on a table.**
- ☐ **Neck pain prevents me from lifting heavy weights, but I can manage light weights if they are conveniently positioned**
- ☐ **I can lift only very light weights.**
- ☐ **I cannot lift or carry anything at all.**

SECTION 4 – READING

- ☐ **I can read as much as I want with no neck pain.**
- ☐ **I can read as much as I want with slight neck pain.**
- ☐ **I can read as much as I want with moderate neck pain.**
- ☐ **I can't read as much as I want because of moderate neck pain.**
- ☐ **I can't read as much as I want because of severe neck pain.**
- ☐ **I can't read at all.**

SECTION 5 – HEADACHES

- ☐ **I have no headaches at all.**
- ☐ **I have slight headaches that come infrequently.**
- ☐ **I have moderate headaches that come infrequently.**
- ☐ **I have moderate headaches that come frequently.**
- ☐ **I have severe headaches that come frequently.**
- ☐ **I have headaches almost all the time.**

SECTION 6 – CONCENTRATION
- ☐ **I can concentrate fully without difficulty.**
- ☐ **I can concentrate fully with slight difficulty.**
- ☐ **I have a fair degree of difficulty concentrating.**
- ☐ **I have a lot of difficulty concentrating.**
- ☐ **I have a great deal of difficulty concentrating.**
- ☐ **I can't concentrate at all.**

SECTION 9 – SLEEPING
- ☐ **I have no trouble sleeping.**
- ☐ **My sleep is slightly disturbed for less than 1 hour.**
- ☐ **My sleep is mildly disturbed for up to 1-2 hours.**
- ☐ **My sleep is moderately disturbed for up to 2-3 hours.**
- ☐ **My sleep is greatly disturbed for up to 3-5 hours.**
- ☐ **My sleep is completely disturbed for up to 5-7 hours.**

SECTION 7 –WORK
- ☐ **I can do as much work as I want.**
- ☐ **I can only do my usual work, but no more.**
- ☐ **I can do most of my usual work, but no more.**
- ☐ **I can't do my usual work.**
- ☐ **I can hardly do any work at all.**
- ☐ **I can't do any work at all.**

SECTION 8 – DRIVING
- ☐ **I can drive my car without neck pain.**
- ☐ **I can drive my car with only slight neck pain.**
- ☐ **I can drive as long as I want with moderate neck pain.**
- ☐ **I can't drive as long as I want because of moderate neck pain.**
- ☐ **I can hardly drive at all because of severe neck pain.**
- ☐ **I can't drive my car at all because of neck pain.**

SECTION 10 – RECREATION
- ☐ **I am able to engage in all my recreational activities with no neck pain at all.**
- ☐ **I am able to engage in all my recreational activities with some neck pain.**
- ☐ **I am able to engage in most, but not all of my recreational activities because of pain in my neck.**
- ☐ **I am able to engage in a few of my recreational activities because of neck pain.**
- ☐ **I can hardly do recreational activities due to neck pain.**
- ☐ **I can't do any recreational activities due to neck pain.**

PATIENT NAME ____ DATE ________________
SCORE __________ [50]

Appendix 6

DISABILITIES OF THE ARM, SHOULDER AND HAND

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	1	2	3	4	5
2. Write.	1	2	3	4	5
3. Turn a key.	1	2	3	4	5
4. Prepare a meal.	1	2	3	4	5
5. Push open a heavy door.	1	2	3	4	5
6. Place an object on a shelf above your head.	1	2	3	4	5
7. Do heavy household chores (e.g., wash walls, wash floors).	1	2	3	4	5
8. Garden or do yard work.	1	2	3	4	5
9. Make a bed.	1	2	3	4	5
10. Carry a shopping bag or briefcase.	1	2	3	4	5
11. Carry a heavy object (over 10 lbs).	1	2	3	4	5
12. Change a lightbulb overhead.	1	2	3	4	5
13. Wash or blow dry your hair.	1	2	3	4	5
14. Wash your back.	1	2	3	4	5
15. Put on a pullover sweater.	1	2	3	4	5
16. Use a knife to cut food.	1	2	3	4	5
17. Recreational activities which require little effort (e.g., cardplaying, knitting, etc.).	1	2	3	4	5
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5
19. Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.).	1	2	3	4	5
20. Manage transportation needs (getting from one place to another).	1	2	3	4	5
21. Sexual activities.	1	2	3	4	5

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
22. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups? *(circle number)*	1	2	3	4	5

	NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
23. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem? *(circle number)*	1	2	3	4	5

Please rate the severity of the following symptoms in the last week. *(circle number)*

	NONE	MILD	MODERATE	SEVERE	EXTREME
24. Arm, shoulder or hand pain.	1	2	3	4	5
25. Arm, shoulder or hand pain when you performed any specific activity.	1	2	3	4	5
26. Tingling (pins and needles) in your arm, shoulder or hand.	1	2	3	4	5
27. Weakness in your arm, shoulder or hand.	1	2	3	4	5
28. Stiffness in your arm, shoulder or hand.	1	2	3	4	5

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SO MUCH DIFFICULTY THAT I CAN'T SLEEP
29. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? *(circle number)*	1	2	3	4	5

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
30. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem. *(circle number)*	1	2	3	4	5

DASH DISABILITY/SYMPTOM SCORE = [(sum of n responses) - 1] x 25, where n is equal to the number of completed responses.
n

A DASH score may not be calculated if there are greater than 3 missing items.

Appendix 7

Search	Query	Items found
#15	Search ((#14) OR #6) AND computer	103
#14	Similar articles for PubMed (Select 20165627)	89
#13	Related Articles by Review for PubMed (Select 20165627)	7
#12	Search a study of visual and musculoskeletal health disorders Schema: title	1
#11	Related Articles by Review for PubMed (Select 15529803)	5
#9	Search neck and shoulder symptoms and disorders Schema: title	2
#8	Search (#6) AND computer	62
#7	Search computer	636293
#6	Similar articles for PubMed (Select 12828389)	134
#5	Related Articles by Review for PubMed (Select 12828389)	5
#4	Search development of neck and hand-wrist symptoms Schema: title	1
#3	Search 25705257[uid] Schema: title	1
#1	Search 2014[pdat] AND Gomes T[first author] AND opioid Schema: title	2