

# Development and Psychometric Assessment of a Health Literacy-Based Questionnaire to Differentiate between Office Workers With and Without Non-Specific Neck Pain

Areerak K, PhD<sup>1</sup>, Janwantanakul P, PhD<sup>1</sup>, van der Beek AJ, PhD<sup>2</sup>

<sup>1</sup> Department of Physical Therapy, Faculty of Allied Health Sciences, Chulalongkorn University, Bangkok, Thailand

<sup>2</sup> Department of Public and Occupational Health, Amsterdam Public Health Research Institute, VU University Medical Center, Amsterdam, The Netherlands

**Background:** Health literacy is an individual's ability to seek, understand, and utilize health information. High health literacy leads to positive health behaviors and better health outcomes.

**Objective:** The primary aim of the present study was to identify domains of health literacy that was able to differentiate between office workers with and without non-specific neck pain, and the results were used to develop a questionnaire. The secondary aim was to determine the discriminative validity, internal consistency, and test-retest reliability of the questionnaire.

**Materials and Methods:** Three professors, 10 physical therapists, and 20 office workers took part in in-depth interviews. Data from 280 office workers with neck pain and 195 without neck pain were used for factor analysis and psychometric property assessment, respectively.

**Results:** Domains of health literacy relating to non-specific neck pain included accessing, understanding, appraising, applying, and extrinsic/intrinsic factors. Only the applying domain, i.e., the working and exercise behaviors of office workers, was able to differentiate between office workers with and without neck pain. The questionnaire was then developed and contained six questions. The score ranged from 0 to 24 and the higher the score indicates better health behaviors. Mann-Whitney U test showed that the total score of the developed questionnaire was significantly lower in office workers with neck pain than in those without neck pain ( $p < 0.05$ ), indicating acceptable discriminative validity.

**Conclusion:** The questionnaire based on health literacy concept was developed. The questionnaire had good discriminative validity, internal consistency, and test-retest reliability. The questionnaire is a promising tool for identifying office workers at risk for the development of non-specific neck pain.

**Keywords:** Health, Health behavior, Screening tool, Risk factor

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Health literacy is an individual's ability to seek, understand, and utilize health information, in order to make judgments and take decision for concerned health care, disease prevention, and health promotion to maintain and improve quality of life<sup>(1,2)</sup>. Literacy generally means the ability to read and write, which are basic skills needed to understand and communicate

information. However, health literacy requires some additional skills, including the ability to find, evaluate, and integrate health information from a variety of contexts<sup>(3,4)</sup>. The main competencies of health literacy consist of 1) access (i.e., the ability to seek, find and obtain health information), 2) understand (i.e., the ability to comprehend health information), 3) appraise (i.e., the ability to interpret, filter, judge, and evaluate health information), and 4) apply (i.e., the ability to communicate and use the information to maintain and improve health)<sup>(5)</sup>.

The World Health Organization (WHO) points out that health literacy implies the achievement of a level of knowledge, personal skills, and confidence to take

## Correspondence to:

Janwantanakul P.

Department of Physical Therapy, Faculty of Allied Health Sciences, Chulalongkorn University, Bangkok 10330, Thailand.

**Phone:** +66-2-2181077, **Fax:** +66-2-2181076

**Email:** [prawit.j@chula.ac.th](mailto:prawit.j@chula.ac.th)

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action to improve personal and community health by changing personal lifestyles and living conditions<sup>(6)</sup>. High health literacy thus leads to positive health behaviors and better health outcomes<sup>(7)</sup>. By improving people's access to health information, and their capacity to use it effectively, health literacy is critical to empowerment<sup>(6,8)</sup>. Sub-optimal health literacy in patients with chronic conditions, such as asthma, diabetes, and rheumatoid arthritis, has been found to associate with poorer health conditions, knowledge, and limited self-management skills<sup>(9-11)</sup>.

One of common health problems in office workers is neck pain with 42% to 69% of office workers reporting neck pain in the preceding 12 months<sup>(12,13)</sup> and 34% to 49% reporting new onset of neck pain annually<sup>(14,15)</sup>. Furthermore, between 60% to 80% of workers with neck pain reported recurrent neck pain one year later<sup>(16)</sup>. An effective approach to manage musculoskeletal disorders, including neck pain, is self-management based on the biopsychosocial model<sup>(10,11)</sup>. Effective self-management essentially requires patients to have adequate health literacy<sup>(1,2)</sup>. Thus, an individual's health literacy level may play an important role in an effort to curb an increasing trend of incidence of neck pain in the society.

Currently, available tools aimed to measure health literacy, such as the Rapid Estimate of Adult Literacy in Medicine (REALM), Test of Functional Health Literacy in Adults (TOFHLA), Short Test of Functional Health Literacy in Adults (S-TOFHLA), or Newest Vital Sign (NVS), assess an individual's reading ability and vocabulary. These tools have been developed for the general population, not for specific groups of patients<sup>(5,17)</sup>. In general, the causes and risk factors attributed to individual conditions are different, thus, the prevention and management should be specific to individual conditions. The knowledge for making judgments and taking decisions regarding healthcare and disease prevention should also have specific context to individual conditions. For example, Gong et al<sup>(2)</sup> and Sabbahi et al<sup>(18)</sup> demonstrated that TOFHLA did not associate with oral health outcomes, because the tool did not measure the oral health domain. Later, researchers specifically developed the Test of Functional Health Literacy in Dentistry (TOFHliD) to measure oral health literacy and found associations between oral health outcomes and TOFHliD<sup>(2,18)</sup>. In 2008, Ishikawa et al<sup>(19)</sup> developed an instrument to assess communicative and critical health literacy among Japanese office workers for health promotion at the workplace. To the authors' knowledge, no study has investigated the

relationship between health literacy and non-specific neck pain. The primary aim of the present study was to identify domains of health literacy that was able to differentiate office workers with neck pain from those without neck pain. The results were then used to develop a questionnaire to differentiate between office workers with and without neck pain. The secondary aim was to determine the discriminative validity, internal consistency, and test-retest reliability of the questionnaire.

## Materials and Methods

The present study was divided into three phases. Phase I consisted of two steps, step I as the identification of questionnaire items, and step II as items and respond scale generation. Phase II involved a process of item reduction. Phase III studied the validity and reliability of the developed questionnaire. The present study was approved by the University Human Ethics Committee. Participants were explained the purpose and procedure of the present study and signed an informed consent form.

### *Phase I: identification of questionnaire items and respond scale generation*

#### • *Participants*

Participants comprised of four groups, professors, physical therapists, and office workers with and without non-specific neck pain. Non-specific neck pain is pain in the neck region (with or without radiation) without any specific systematic disease being detected as the underlying cause of the complaint<sup>(20)</sup>. A sample of professors who taught musculoskeletal physical therapy and had at least five years of clinical experience in musculoskeletal physical therapy in a Thai university were recruited. Physical therapists working in a clinic or a hospital in Thailand and having at least five years of clinical experience in musculoskeletal physical therapy, and both male and female office workers with and without non-specific neck pain in the previous six months, aged between 18 and 55 years, who worked full-time, and had at least five years of experience as office workers were recruited. Office workers were excluded if they reported pregnancy, history of trauma or accidents in the spinal region or had a history of spinal and intra-abdominal surgery in the previous 12 months, or had been diagnosed with congenital anomaly of the spine, rheumatoid arthritis, infection of the spine and discs, ankylosing spondylitis, spondylolisthesis, spondylosis, tumor, systemic lupus erythymatosus (SLE), or osteoporosis.

- **Procedures**

*In step I:* Identification of questionnaire items, professors, physical therapists, and office workers with and without non-specific neck pain were in-depth interviewed. Semi-structured face to face interviews were used to gather information regarding self-management of neck pain. The semi-structured interview included four domains of health literacy (i.e., accessing, understanding, appraising, and applying). The data were analyzed by three independent researchers using content analysis and descriptive meta-metrics.

*In step II:* Items and respond scale generation, the selection of content to generate questions was conducted. The selection criteria were:

- 1) The content should be related to self-management of neck pain.
- 2) The content should be related to the ability to seek, understand, appraise, and apply information to manage neck pain.
- 3) The content should be able to differentiate office workers with neck pain from those without neck pain.

A researcher generated questions and defined responses to each question in the questionnaire. For the domain of accessing, appraising, and applying, a five-point Likert-style format was used for responses to each question. For the domain of understanding, multiple-choice format was used for responses to each question. The first version of questionnaire was reviewed and assessed for its content validity by three experts. Index of item objective congruence (IOC) was used for content validity analysis and IOC was set at 0.5 or greater<sup>(21,22)</sup>.

### **Phase II: item reduction**

- **Participants**

A sample of office workers with and without non-specific neck pain in two large-scale enterprises in Bangkok was recruited. The enterprises participating in the present study were a public university and a commercial bank. Office workers were included and excluded according to the criteria described in the phase of identification of questionnaire items and respond scale generation (Phase I).

- **Procedures**

Office workers were approached and invited to participate in the present study. They were informed of the objective and details of the research and asked to provide informed consent upon agreement to participate. Subjects were asked to complete the

questionnaire developed in the phase of identification of questionnaire items and respond scale generation (Phase I) (the first version). The data were analyzed using exploratory factor analysis (EFA) to determine the number of health literacy domains and the optimal number of questions to retain in the questionnaire. The number of health literacy domains in the data set were estimated using eigenvalue greater than 1 and the Scree test. The questions were included in the questionnaire if a factor loading was more than 0.6. The second version of questionnaire was developed at the end of item reduction phase (Phase II).

### **Phase III: validity and reliability testing of the developed questionnaire**

- **Participants**

Participants in the phase of validity and reliability testing of the developed questionnaire (Phase III) were identical to that those described in the phase of item reduction (Phase II).

- **Procedures**

Office workers were approached and invited to participate in the present study. They were informed of the objective and details of the research and asked to provide informed consent upon agreement to participate. Subjects were asked to complete the questionnaire developed in the phase of item reduction (Phase II) (the second version). The data were analyzed to determine its validity and reliability. Confirmatory factor analysis (CFA) was conducted to confirm whether the questionnaire from the phase of item reduction (Phase II) had good model fit, using LISREL 8.72<sup>(23)</sup>. Model fit was assessed using a combination of absolute and incremental fit indices as root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), and comparative fit index (CFI). The criteria for good model fit were RMSEA of less than 0.08, SRMR of less than 0.09, and CFI of less than 0.95. Discriminative validity was evaluated by comparing the total score of the questionnaire (final version) between office workers with and without non-specific neck pain by using the Mann-Whitney U test. The level of significance was set to p-value of less than 0.05<sup>(24,25)</sup>. Internal consistency was assessed using Cronbach's alpha.

The test-retest reliability of the questionnaire was conducted on 100 participants who were randomly selected from both office workers with and without non-specific neck pain groups (n = 50 in each group). Each subject was asked to complete the questionnaire

**Table 1.** Characteristics of participants

Characteristics	Phase of item reduction (Phase II)	Phase of validity and reliability testing of the
	(n = 280)	developed questionnaire (Phase III) (n = 195)
	n (%)	n (%)
Sex		
Male	92 (32.9)	49 (25.1)
Female	188 (67.1)	146 (74.9)
Age (years), Mean±SD	39.5±8.3	40±7.9
20 to 29	33 (11.8)	16 (8.2)
30 to 39	111 (39.6)	76 (39.0)
40 to 49	94 (33.6)	70 (35.9)
50 to 55	42 (15.0)	33 (16.9)
History of neck pain		
Yes	130 (46.4)	91 (46.7)
No	150 (53.6)	104 (53.3)

SD=standard deviation

on two occasions over a two-week period. The intraclass correlation coefficient (ICC [3,1]) was calculated for test-retest reliability using the SPSS statistics software, version 17.0.

## Results

### *Phase I: identification of questionnaire items and respond scale generation*

*In step I:* identification of questionnaire items, 33 interviews were conducted across the four groups: three professors, 10 physical therapists, 10 office workers with non-specific neck pain, and 10 office workers without non-specific neck pain. Data from the interviews were analyzed by three independent researchers using content analysis and descriptive meta-metric. This process revealed five domains reflecting non-specific neck pain health literacy in office workers as 1) accessing, 2) understanding, 3) appraising, 4) applying, and 5) extrinsic/intrinsic factors influencing health literacy.

*In step II:* items and respond scale generation, according to the selection criteria, four potential domains for measurement development were identified, including accessing, understanding, applying, and extrinsic/intrinsic factors influencing health literacy. The appraising domain was excluded because it was unable to differentiate between office workers with and without non-specific neck pain. The first version of the questionnaire consisted of 39 questions in four domains as six questions in accessing, nine questions in understanding, 21 questions in applying, and three questions in extrinsic/intrinsic factors influencing health literacy. The results from the item review of experts showed the index

of IOC of all questions to be 0.92, indicating good content validity.

### *Phase II: item reduction*

Two hundred eighty office workers completed the questionnaire, a response rate of 100%. Table 1 presented the baseline characteristics of participants. Responses from the participants were analyzed by EFA. According to the criteria of factor loading greater than 0.6, only the applying domain of health literacy, which consisted of seven questions, was included in the questionnaire. Five factors were linked with these seven questions, according to the criteria of eigenvalue greater than 1 (Table 2). Factor 1 was relating to working posture, Factor 2 relating to rest break, and Factor 3 relating to working habit consisted of one question each, Factor 4 relating to pain management while working, and Factor 5 relating to neck muscle exercise consisted of two questions each. In summary, the second version of questionnaire consisted of seven questions in five factors.

### *Phase III: validity and reliability testing of the developed questionnaire*

One hundred ninety-five office workers completed the questionnaire, a response rate of 100%. Table 1 presented the baseline characteristics of participants. The CFA revealed that the second version of questionnaire did not have good fit. Thus, one question (i.e., if you have a neck pain during work, will you stretch neck muscle to release pain?) was excluded from the second version of the questionnaire because the question correlated with more than one factor (Factor 4 and 5), indicating its collinearity for

**Table 2.** Factor loading for seven questions in the developed questionnaire

	Factor loading				
	Posture	Rest break	Working habit	Pain management	Exercise
Question 1	0.658				
Question 2		0.908			
Question 3			0.742		
Question 4				0.797	
Question 5				0.873	0.294
Question 6	0.238				0.709
Question 7					0.932

Question 1 in Factor 1 (working posture); Question 2 in Factor 2 (rest break); Question 3 in Factor 3 (working habit); Question 4 and 5 in Factor 4 (pain management); Question 6 and 7 in Factor 5 (neck-related exercise)

**Table 3.** Discriminative validity between office workers with and without non-specific neck pain (total score)

	Office workers with non-specific neck pain (n = 91) Median (P <sub>25</sub> to P <sub>75</sub> )	Office workers without non-specific neck (n = 104) Median (P <sub>25</sub> to P <sub>75</sub> )	p-value
Total scores of NHBOW questionnaire	11 (8 to 13)	12 (10 to 14)	0.005

NHBOW=neck pain-specific health behavior in office workers  
Mann-Whitney U tests; significant differences (p<0.05)

measuring neck pain-specific health literacy in office workers with two other factors. As a result, the final (third) version of questionnaire, which consisted of six questions in five factors in the applying domain of health literacy, presented a good fit (RMSEA 0.07, SRMR 0.025, and CFI 0.98). Factor 1 relating to working posture, Factor 2 relating to rest break, Factor 3 relating to working habit, and Factor 4 relating to pain management while working consisted of one question each. Factor 5 relating to neck muscle exercise consisted of two questions. Discriminative validity assessment showed that a group of office workers with non-specific neck pain had statistically lower total scores on the questionnaire than a group of office workers without non-specific neck pain (p<0.05) (Table 3). Cronbach's alpha reliability coefficient was 0.64 and 0.53 when tested in office workers with and without non-specific neck pain, respectively, indicating moderate internal consistency<sup>(26)</sup>. The test-retest reliability of the questionnaire demonstrated good reliability (ICC [3,1]=0.75).

## Discussion

The purpose of the present study was to develop a questionnaire, based upon a conceptual framework of health literacy, to differentiate between office workers with and without non-specific neck pain as well as to determine the discriminative validity, internal consistency, and test-retest reliability of the developed

questionnaire. The development of questionnaire started with in-depth interview with diverse participant groups and selection of content to generate questions. The researchers appraised a broad range of groups to qualitatively identify and understand potential constructs of non-specific neck pain health literacy for office workers. The conceptualization of non-specific neck pain health literacy devised from experiences of health professionals and physical therapists as well as from the office workers' perspective. The EFA and CFA were then undertaken to identify and confirm the explicit concept of non-specific neck pain health literacy for office workers<sup>(27)</sup>. The results showed that only the applying domain of health literacy, not the accessing, understanding, appraising, and extrinsic/intrinsic factors influencing health literacy domains, was able to differentiate office workers with neck pain from those without neck pain. An increase in media reports and rapid diffusion of the internet facilitates access to health information for all. The target population of the current study, i.e., office workers, is commonly educated. Therefore, they are likely to be able to understand and appraise health information. The applying information domain thus becomes a single important component of health literacy to differentiate between office workers with and without non-specific neck pain. Thus, the questions in the applying domain, which involved with behaviors of office workers, were used to develop the questionnaire



called “Neck pain-specific Health Behavior in Office Workers (NHBOW)” (Appendix).

The NHBOW comprised six questions. Question 1 to 4 involve behaviors of office workers during work, while Question 5 to 6 concerns neck-related exercise. The total score of the NHBOW ranges from 0 to 24, with higher scores indicating better health behaviors. It is hypothesized that office workers with better health behaviors possess better health outcomes than those with poor health behaviors<sup>(7)</sup>. Office jobs require sitting for many hours of computer work behind a screen, leading to continuous and static contraction of postural muscles. The forward head posture while sitting has been identified as a risk factor for the development and increased frequency and severity of neck pain<sup>(28)</sup>. Irregular head and body postures were a main predictors for the occurrence of neck complaints<sup>(29)</sup>. Perceived muscular tension was a strong predictor of future neck-shoulder symptoms in symptom-free office workers and was the strongest risk factor for the onset of neck pain<sup>(30,31)</sup>. Several hypotheses have been proposed for the pathogenesis of work-related musculoskeletal symptoms and pain. One possible pathomechanism is that muscle damage due to selective and sustained low-intensity activation of type I muscle fibers (the Cinderella hypothesis) leads to Ca<sup>2+</sup> accumulation and homeostatic disturbances in the active muscles because of poor blood circulation and an impaired metabolic waste removal mechanism and muscle cell damage, respectively<sup>(32,33)</sup>. In the same way, a proper recovery of muscles is believed to be crucial in avoiding musculoskeletal disorders. In this context, the general purpose of exposure variation is to give the motor units that would otherwise be overloaded an opportunity to relax<sup>(34)</sup>. Rest-break interventions have been recommended to decrease musculoskeletal symptoms<sup>(13)</sup>. Individual operators can perform some physical activity, exercise, or change their posture during the breaks<sup>(35)</sup>. In addition, previous epidemiological studies found low muscle endurance among office workers with neck pain<sup>(36)</sup>. Sihawong et al<sup>(37)</sup> reported that neck muscle stretching and endurance exercise has been found to be beneficial in the prevention of non-specific neck pain in office worker.

The NHBOW showed good validity and reliability for psychometric properties, including discriminative validity of the domains, internal consistency, and test-retest reliability. Discriminative validity assesses whether the questionnaire can discriminate office workers in different groups, i.e., office workers with and without non-specific neck pain. It was evaluated

by comparing the total score of the NHBOW between office workers with and without non-specific neck pain groups. The results showed that office workers with non-specific neck pain had significantly lower total scores than office workers without non-specific neck pain, suggesting a discriminative validity of the NHBOW<sup>(24,38)</sup>. The internal consistency was investigated with the use of Cronbach’s alpha coefficient. According to Bowling<sup>(39)</sup>, an alpha of 0.5 or higher is considered as a sign of acceptable internal consistency. In the present study, internal consistency measured by Cronbach’s alpha was 0.53 and 0.64, indicating that the items in the NHBOW are homogeneous and thus, are measuring the same underlying concept. Test-retest reliability assesses the extent to which scores are stable and reproducible. Reliability coefficients were interpreted as ICCs below 0.75 indicating poor to moderate reliability, and equal or above 0.75 indicating good reliability<sup>(22,27)</sup>. In the present study, the coefficient of stability was 0.75 as represented by the Intraclass Correlation Coefficient (ICC [3,1]), demonstrating good test-retest reliability of the questionnaire.

The NHBOW is a promising tool for use to identify office workers at risk who are in need of early intervention to prevent the development of non-specific neck pain. Because the questionnaire is easy and quick to administrate, it can be used at a population level<sup>(40,41)</sup>. However, the cross-sectional design of the present study did not accommodate an evaluation of the predictive validity of the NHBOW. Further prospective observational and experimental studies are required to assess the predictive validity of the NHBOW. In addition, the NHBOW can be utilized as a guide of important behaviors to prevent non-specific neck pain in office workers. Previous studies found that a workstyle intervention focused on behavioral change was effective in improving some elements of work style behavior and reducing pain on the long-term in computer workers with neck and upper limb symptoms<sup>(42,43)</sup>. Future studies should investigate the effectiveness of an intervention focusing on changes in behaviors identified in the present study in the prevention of neck pain in office workers.

A major strength of the present study is the application of multiple processes to develop the questionnaire, including in-depth interviews as well as EFA and CFA. In addition, the number of office workers participating in the study and the high response rate enhanced the internal validity of the study. There are at least two methodological limitations that are

noteworthy. First, the use of a convenience sample restricts the external validity of the present study. Thus, generalization of the results from the present study to other working populations should be made with caution. Second, the total score was calculated from the five factors. The unequal items of each factor mean that greater weight is given to Factor 5, which consists of two questions. One should be aware of this when generating interpretations based upon the total score calculation. An alternative would be to use the average of the two questions in the total score.

## Conclusion

The NHBOW questionnaire contained six questions with scores ranging from 0 to 24, with higher scores indicating better health behaviors. The NHBOW questionnaire was developed and showed acceptable validity and reliability for psychometric properties, including discriminative validity of the domains, internal consistency, and test-retest reliability. The working and exercise behaviors of office workers were identified in the present study to be associated with non-specific neck pain in office workers. A further study should investigate whether the NHBOW can predict onset neck pain in office workers.

## What is already known on this topic?

Effective self-management of musculoskeletal disorders requires patients to have adequate health literacy, which is an individual's ability to seek, understand, and utilize health information.

## What this study adds?

A health literacy-based questionnaire to differentiate between office workers with and without non-specific neck pain was developed. The questionnaire showed acceptable validity and reliability for psychometric properties, including discriminative validity of the domains, internal consistency, and test-retest reliability.

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## Ethics approval and consent to participate

All participants were informed about the objectives and details of the study and were asked to provide informed consent upon agreement

to participate. The study was approved by the Chulalongkorn University Human Ethics Committee.

## Authors' contributions

The authors have contributed in the following ways: Areerak K provided concept/research design, data collection, data analysis, and manuscript writing. Janwantanakul P and van der Beek AJ provided concept/research design, data analysis, and manuscript writing. All authors read and approved the final manuscript.

## Availability of data and materials

The datasets that support the findings of the present study are available from the corresponding author on reasonable request.

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## Conflicts of interest

The authors declare no conflict of interest.

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