Research Report

Incidence of Common Postural Abnormalities in the Cervical, Shoulder, and Thoracic Regions and Their Association with Pain in Two Age Groups of Healthy Subjects

Patricia Griegel-Morris
Keith Larson
Krissann Mueller-Klaus
Carol A Oatis

The purposes of this study were to identify the incidence of postural abnormalities of the thoracic, cervical, and shoulder regions in two age groups of healthy subjects and to explore whether these abnormalities were associated with pain. Eighty-eight healthy subjects, aged 20 to 50 years, were asked to answer a pain questionnaire and to stand by a plumb line for postural assessment of forward head, rounded shoulders, and kyphosis. Subjects were divided into two age groups: a 20- to 35-year-old group ($\bar{X}$=25, SD=6.3) and a 36- to 50-year-old group ($\bar{X}$=47, SD=2.6). Interrater and intrarater reliability (Cohen's Kappa coefficients) for postural assessment were established at .611 and .825, respectively. Frequency counts revealed postural abnormalities were prevalent (forward head=66%, kyphosis=38%, right rounded shoulder=73%, left rounded shoulder=66%). No relationship was found between the severity of postural abnormality and the severity and frequency of pain. Subjects with more severe postural abnormalities, however, had a significantly increased incidence of pain, as determined by chi-square analysis (critical χ^2=6, df=2, P<.05). Subjects with kyphosis and rounded shoulders had an increased incidence of interscapular pain, and those with a forward-head posture had an increased incidence of cervical, interscapular, and headache pain. The results of this study suggest a relationship between the presence of some postural abnormalities and the incidence of pain. [Griegel-Morris P, Larson K, Mueller-Klaus K, Oatis CA. Incidence of common postural abnormalities in the cervical, shoulder, and thoracic regions and their association with pain in two age groups of healthy subjects. Phys Ther. 1992;72:425–431.]

Key Words: *Kyphosis; Pain; Posture, general; Shoulder; Spine.*

P Griegel-Morris, PT, is Staff Physical Therapist, The Philadelphia Institute for Physical Therapy, St Leonard's Ct, 39th and Chestnut Streets, Philadelphia, PA 19104. Address correspondence to Ms Griegel-Morris at 808 Foxmeadow Dr, Royersford, PA 19468 (USA).

K Larson, PT, is Staff Physical Therapist, The Philadelphia Institute for Physical Therapy.

K Mueller-Klaus, PT, is Staff Physical Therapist, George Washington University Hospital, 901 23rd St NW, Washington, DC 20037.

CA Oatis, PhD, PT, is Co-principal, The Philadelphia Institute for Physical Therapy, and Associate Professor, Department of Physical Therapy, Beaver College, Easton and Church Roads, Glenside, PA 19038.

Ms Griegel-Morris, Mr Larson, and Ms Mueller-Klaus were students in the master's degree program, Department of Physical Therapy, Beaver College, Glenside, PA, when this study was conducted in partial fulfillment of their degree requirements.

The results of this study were presented as a paper at the 1987 State Meeting of the Pennsylvania Chapter of the American Physical Therapy Association and in poster format at the Annual Conference of the American Physical Therapy Association; June 12–16, 1988; Las Vegas, NV.

This study was approved by the Beaver College Ethics Review Board.

This article was submitted January 16, 1991, and was accepted February 18, 1992.

Postural education and assessments are a part of physical therapy education and clinical practice. The importance of normal upright posture has been proposed since the early 1900s when it was described as a state of balance requiring minimal muscular effort to maintain.[1,2] Attempts were made to define ideal posture by alignment of significant landmarks such as the acromial process or the malleolus or by general body positions such as an upright position with nonexaggerated back curves, but there was little standardization of methods of measuring posture.[1,3–7]

Today, proper posture is still believed to be a state of musculoskeletal balance that involves a minimal amount of stress or strain to the body.[8] A standard for normal alignment as described by Kendall and McCreary[8] is frequently used by physical therapists. The points of reference consisting of the lobe of the ear, the seventh cervical vertebra, the acromial process, the greater trochanter, just anterior to midline of the knee, and slightly anterior to the lateral malleolus form a theoretical line around which the body is balanced in perfect skeletal alignment, yielding equal weight distribution and maximum joint stability.

Several studies[9–11] have documented a high incidence of postural abnormalities in a given population; however, methods of postural measurement were poorly defined. Abnormalities noted have included forward head, rounded shoulders, excessive thoracic kyphosis and lumbar lordosis, and asymmetrical shoulder heights (CA Oatis, personal communication, The Philadelphia Institute for Physical Therapy; October 23, 1986).[5–7,9,11–17]

The question remains as to what is the importance of maintaining normal postural alignment. Deviation from what is described as normal alignment suggests a system of imbalance, or abnormal strain on the musculoskeletal system. It has been suggested that conditions such as primary scapulocostal syndrome occur in middle-aged individuals whose posture has deteriorated.[18] Imbalances have been causally implicated in injury and pain; however, these findings have not been documented by controlled studies of such relationships.*

Based on the concept that postural abnormalities cause pain and injury, postural education and correction have been used as treatment approaches for alleviating pain.[2,5,8,13–15,19,22,24–26] We believe, however, that the use of posture correction as a treatment approach must be justified by controlled studies that identify a specific link between postural abnormalities and pain.

The purposes of this study were (1) to document the incidence and severity of postural abnormalities in two age groups of healthy subjects and (2) to determine whether these abnormalities are associated with pain. In this study, we investigated posture and pain in the thoraco-cervical-shoulder (TCS) region. We hypothesized that the incidence of postural abnormalities would be high, especially in an older population, and that a correlational relationship would exist between the severity of postural abnormality and the incidence, severity, and frequency of pain.

Method

Subjects

The sample consisted of 88 healthy volunteers (41 men and 47 women). Subjects were divided into two age groups in order to compare the younger subjects with the older subjects. Fifty-eight subjects were in the 20- to 35-year-old group ($\bar{X}$=25 years, SD=6.3 years), and 30 subjects were in the 36- to 50-year-old group ($\bar{X}$= 47 years, SD=2.6 years). These categories were chosen because it has been suggested that the effects of poor posture might be cumulative and therefore might increase in severity after the age of 35 years.[18] A sample of convenience was used, with no attempt at random selection. All subjects signed informed consent forms before participation. To control for the possible effects of growth on posture, persons younger than 20 years of age were excluded. In order to prevent bias, both physical therapy professionals and students were excluded because of their knowledge of correct postural alignment. Also excluded were persons with a medical history of idiopathic scoliosis and persons with a corrected leg-length discrepancy.

Procedure

A pain questionnaire designed by the experimenters (Appendix) was used to determine the location, frequency, and perceived severity of any pain in specific areas of the TCS region as identified on a body diagram (Fig. 1). Subjects were asked to identify their name, age, gender, occupation, handedness, and any history of scoliosis or other skeletal problems of which they were aware. Subjects were questioned regarding the frequency and severity of pain experienced in the right and left anterior thorax, right and left posterior neck, right and left shoulders, interscapular regions, and head. Subjects were asked to grade any pain experienced during a typical day while at rest or during sitting, standing, or activity, with contact sports excluded. A numerical rating scale with grades of 0 to 10 was chosen because it was similar to a scale used to obtain reliable and easily understood measurements of pain severity.[27] Data from the pain scale were classified operationally as follows: 0=no pain, 1–3=mild pain, 4–7= moderate pain, and 8–10=severe pain. A four-point pain frequency scale was also included, using the following operational definitions: never, rarely (once a month or less), occasionally (2–3 times a month), or frequently (1–3 times a week or more). Duration of pain was not specifically addressed in the questionnaire.

Posture was assessed by the three experimenters with subjects standing comfortably and quietly in front of and alongside a plumb line suspended from the ceiling. Subjects were asked to wear a bathing suit or other appropriate attire to adequately expose the areas in the TCS region necessary to perform a posture evaluation using the following landmarks: the lobe of the ear, the seventh cervical vertebra, the acromial process, the thoracic spine, and the lateral malleolus. *Normal posture*, as defined by Kendall and McCreary,[8] is a vertical line passing through the lobe of the ear, the seventh cervical vertebra, the acromial process, the greater trochanter, just anterior to the midline of

*References 2, 4, 5, 8, 10, 12, 13, 15, 18–23.

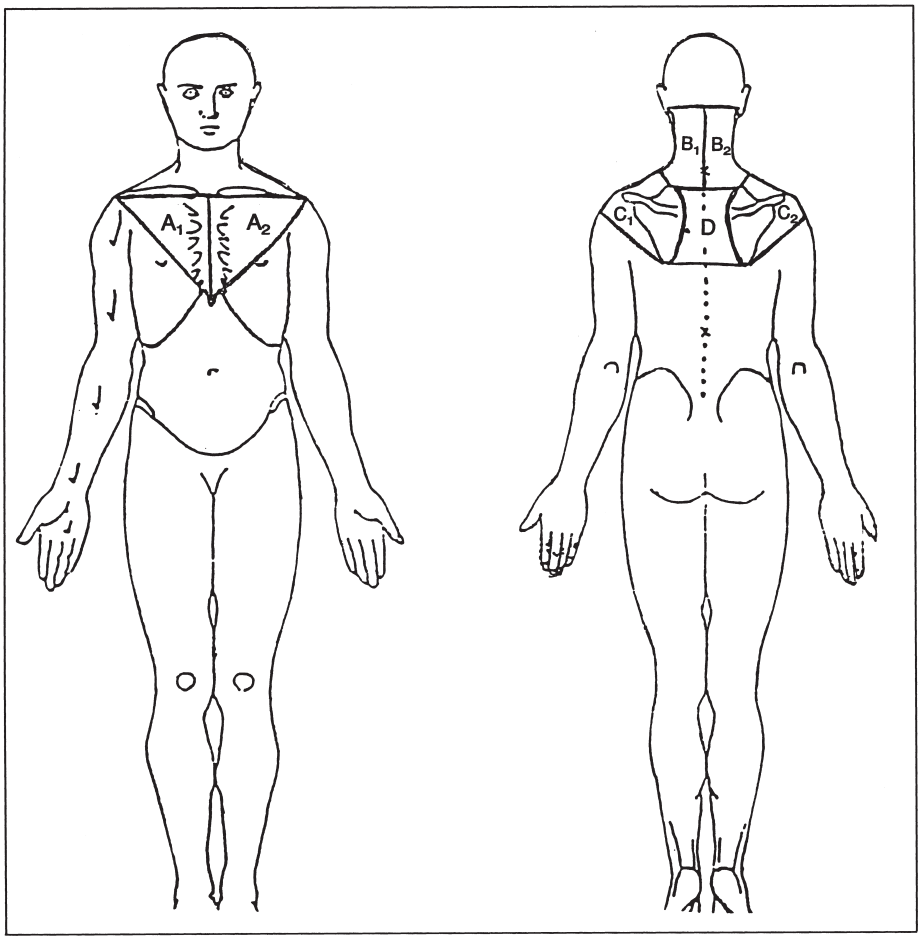

Figure 1. *Body diagram used in conjunction with the pain questionnaire to define body regions. (A_1=right pectoral region, A_2=left pectoral region, B_1=left posterior cervical region, B_2=right posterior cervical region, C_1=left shoulder region, C_2=right shoulder region, D=interscapular region.)*

the knee, and slightly anterior to the lateral malleolus. As viewed from the sagittal plane, forward-head position (anterior deviation of the head as observed at the lobe of the ear), rounded shoulders (anterior displacement of the acromion), and increased thoracic kyphosis (an increase in the convexity of the thoracic spine) were observed from the left and right. Postural abnormalities were operationally defined on a six-point severity scale as follows: normal=0, mild=1, mild+=2, moderate=3, moderate+=4, and severe=5. For purposes of analysis, postures of forward head and rounded shoulders graded as normal and mild were considered to be within normal limits (WNL) (center of landmark in line with or up to 1 cm anterior to the plumb line) and assigned a grade of 1, mild+ and moderate deviations were grouped as moderate (posterior border of landmark in line with or displaced up to 1 cm anterior to the plumb line) and assigned a grade of 2, and moderate+ and severe deviations were grouped as severe (posterior border of bony landmark displaced >1 cm beyond the plumb line) and assigned a grade of 3. Kyphosis was qualitatively assessed as WNL, moderate, or severe, with no specific operational definitions, as is typically done in our clinic with measures having established interrater and intrarater reliability.

Data Analysis

Prior to initiation of the study, a training session to establish procedures and techniques for assessing posture was undertaken by the experimenters with an experienced clinical therapist (15 years' experience and instructor of posture and biomechanics). The experienced clinician served as a criterion for comparison.

Cohen's Kappa coefficients were used to determine intrarater and interrater reliability in rating postural severity for each subject. Intrarater reliability was established by the three experimenters using 10 subjects who were reassessed in random order. Interrater reliability was established using 5 subjects who were assessed by the three experimenters and the experienced clinician. Cohen's Kappa for intrarater reliability in assessment of postural severity by the three experimenters was established at .825. The Kappa for interrater reliability of the three experimenters and the experienced clinician was established at .611. Criteria for reliability have been defined as follows: <0 (poor), 0 to .20 (slight), .21 to .40 (fair), .41 to .60 (moderate), .61 to .80 (substantial), and .81 to 1.00 (almost perfect).[28] Experimenters acted independently in gathering data for the study once reliability was established.

Frequency counts and percentages were used to determine the incidence of postural abnormalities in the two age groups (Fig. 2). Spearman rank-order correlations were used to relate the severity of postural deformity for forward head, kyphosis, and rounded shoulders to the severity and frequency of pain in the TCS region as indicated by a body diagram (Fig. 1). Chi-square analysis was used to determine whether the difference in incidence of postural abnormalities in the two different age groups was significant ($P<.05$) (Fig. 2). Chi-square analysis was also used to determine whether there was a relationship between incidence of postural abnormality and incidence of pain ($P<.05$). Frequency counts were made to determine the incidence of persons in each postural category (ie, WNL, moderate, and severe) experiencing any degree of pain (persons reporting severity levels of >0), regardless of frequency or severity. If inci-

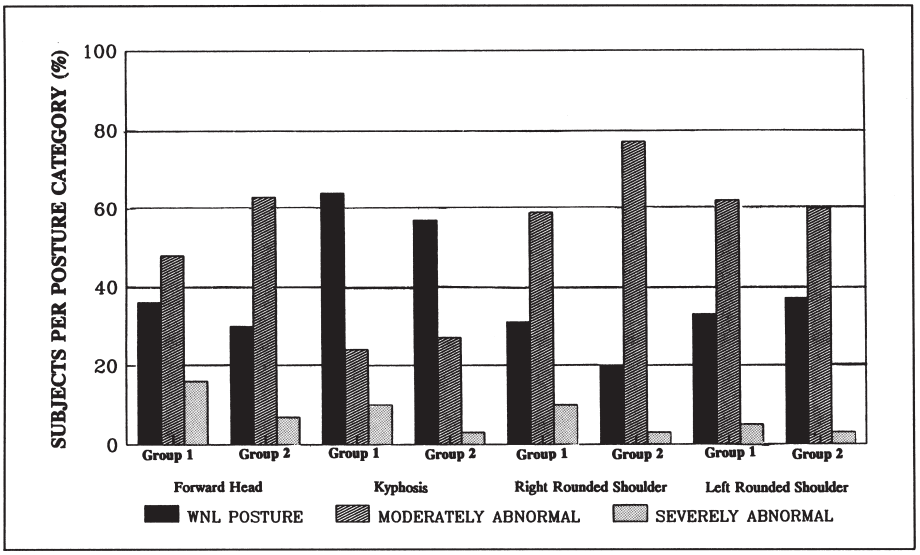

Figure 2. *Incidence of postural abnormalities forward head, kyphosis, and rounded shoulders in two age groups: group 1=20- to 30-year-old group (n=58), group 2=36- to 50-year-old group (n=30). (Within normal limits [WNL] posture=center of landmark in line with or displaced up to 1 cm anterior to plumb line, moderately abnormal=posterior border of landmark in line with or displaced up to 1 cm anterior to plumb line, severely abnormal=posterior border of landmark displaced >1 cm beyond plumb line.)*

dence of pain was unrelated to postural severity, it would be expected that an equal distribution of persons experiencing pain would occur in each postural category. The percentage of the subjects in a postural category reporting pain was plotted for each pain region (Figs. 3–5).

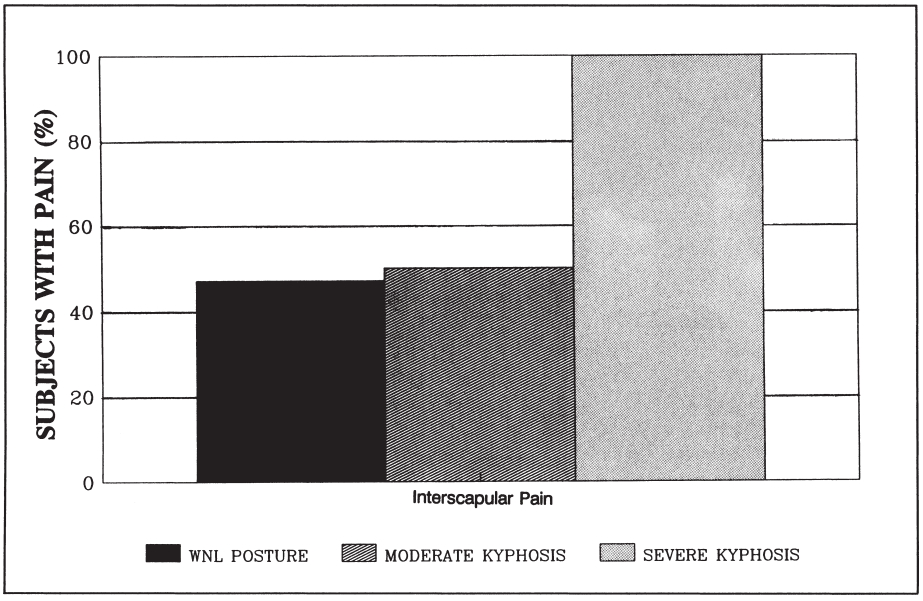

Figure 3. *Percentage of subjects experiencing interscapular pain per postural category of kyphosis. (Kyphosis was qualitatively assessed as within normal limits [WNL], moderate, or severe, with no specific operational definitions.)*

Results

Based on Kendall and McCreary's criteria for normal posture, Figure 2 shows that the majority of the sample had some degree of postural abnormality in the TCS region, with the greatest percentage being in the moderate category for forward-head position and right and left rounded shoulders. The incidence of postural abnormality in the TCS region was as follows: forward head=66%, kyphosis=38%, right rounded shoulder=73%, and left rounded shoulder=66%.

Chi-square analysis revealed no significant difference in the incidence of deformity between age groups for each postural category ($P<.05$, rows=2, columns=3, $df=2$). Further analyses, including chi-square analysis and frequency counts used in graphing, were therefore performed, grouping the data for both age categories to increase the power of analysis.

Spearman rank-order correlation to assess the relationship between severity of postural abnormality and the variables of pain frequency and pain severity revealed no difference. The correlations ranged from .00 to .46 for the younger subjects and from .00 to .30 for the older subjects.

The incidence of pain increased in the subjects with more severe postural abnormalities (Figs. 3–5). Some subjects in the WNL category, however, also reported pain. Chi-square analysis revealed a significant difference (χ^2 critical=6, $df=2$, $P<.05$) in the incidence of reported pain among severity classifications for the following postural deformities and their associated areas of pain: kyphosis and interscapular pain ($\chi^2=6.99$), forward head and right cervical pain ($\chi^2=7.05$), forward head and left cervical pain ($\chi^2=8.21$), forward head and headache ($\chi^2=6.45$), forward head and interscapular pain ($\chi^2=9.79$), left rounded shoulder and interscapular pain ($\chi^2=7.15$), and right rounded shoulder and interscapular pain ($\chi^2=7.07$). A significant rela-

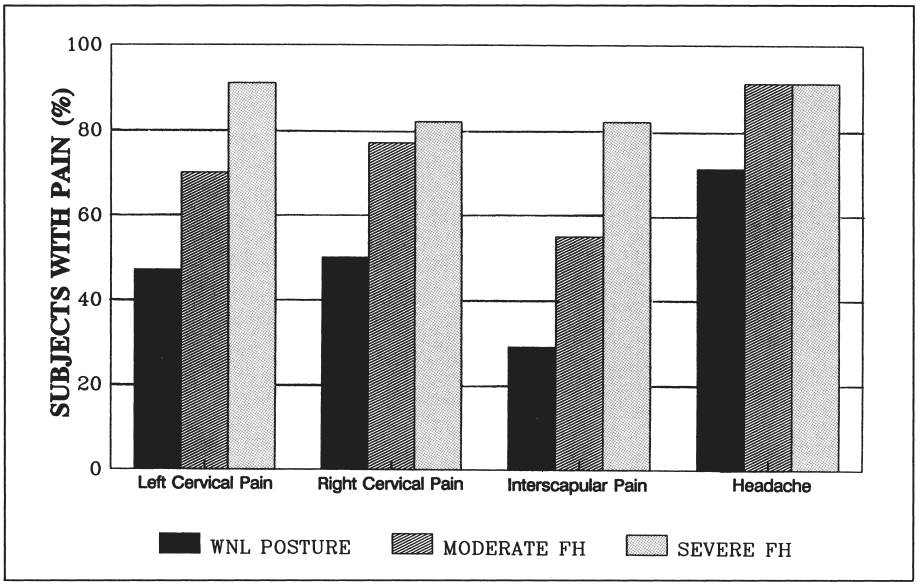

Figure 4. *Percentage of subjects experiencing left and right posterior neck pain, interscapular pain, or headache per postural category of forward head (FH). (Within normal limits [WNL] posture=center of lobe of ear in line with or up to posterior border of lobe, moderate FH=posterior border of lobe to posterior border of ear in line with plumb line, severe FH=posterior border of ear beyond plumb line.)*

tionship was not found between rounded shoulders and pectoral pain or between rounded shoulders and shoulder pain in these subjects. The results indicate that the subjects in this study with more severe postural abnormalities experience a higher incidence of pain at some level for the above-mentioned categories.

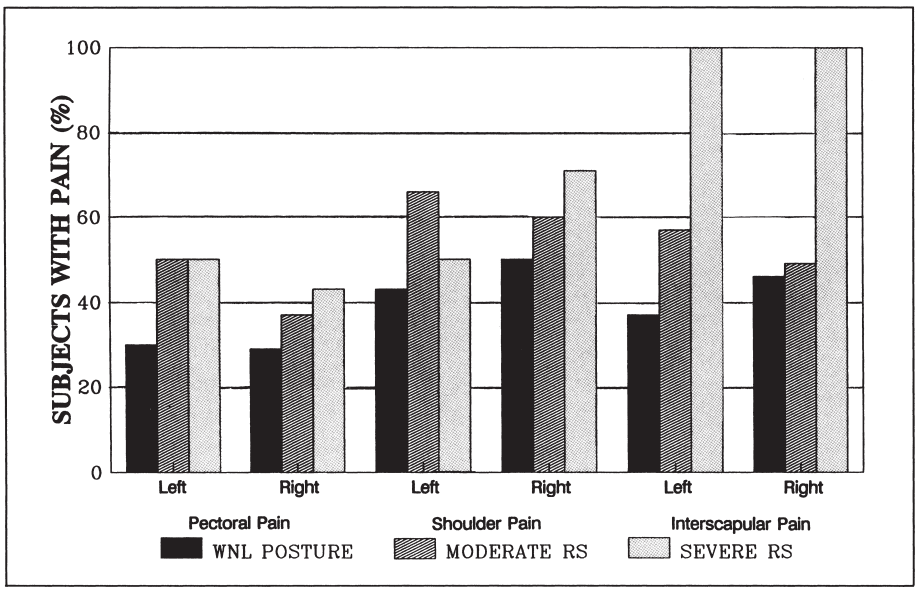

Figure 5. *Percentage of subjects experiencing left and right pectoral, shoulder, or interscapular pain per postural category of rounded shoulder (RS). (Within normal limits [WNL] posture=center of acromion in line with or up to 1 cm anterior to plumb line, moderate RS=posterior border of acromion in line with or up to 1 cm anterior to plumb line, severe RS=posterior border of acromion >1 cm anterior to plumb line.)*

Discussion

A large percentage of the subjects in this study displayed some degree of postural abnormality in the cervical, shoulder, and upper-back region. Sedentary habits, poorly equipped work sites that result in prolonged positioning in poor postural alignment, and lack of postural awareness may be partly responsible for this finding.

It was expected that the severity of postural abnormalities would be greater in an older population as compared with a younger population. Habits of "falling into gravity" are proposed to become exacerbated with advancing age.[18] There was no significant difference, however, between the two age groups in this study. There may be no significant difference in postural abnormalities in different age groups, or the effects of age on posture may appear later in life. The effects of age on posture remain an important area for investigation because the postural abnormalities seen in a younger population may be more amenable to change. A longitudinal study may better assess the relationship between age, posture, and pain.

It has been suggested in the literature that persons with more severe postural abnormalities might experience more severe and more frequent pain. This relationship was not supported by Spearman rank-order correlations in this sample. A number of individuals with normal posture were found to have significant pain, whereas some individuals with more severe postural deviations in the TCS region were found to have minimal pain. Other factors such as activity level and possible compensations for poor posture and pain need to be addressed in order to better understand this relationship. In addition, an individual's experience of pain intensity may affect the degree of pain reported in a questionnaire. It is important to recognize the subjective nature of pain and the difficulty with its quantification. Persons with a history of pain or those who are more tolerant of pain may believe that it is normal to experience some discomfort and may not

report this discomfort on a pain questionnaire. It may be of value in subsequent studies to replace the word "pain" with "discomfort" in order to elicit a more inclusive response from subjects. In this study, any pain that was reported on the questionnaire was considered to be worth noting and was therefore incorporated into the frequency analysis of pain.

Although a relationship between pain frequency and severity and the severity of postural abnormalities was not supported, chi-square analysis did reveal a significant increase in the incidence of pain in persons with the most severe postural abnormalities. This finding suggests that persons with more severe postural abnormalities are more likely to experience pain than are those with less severe abnormalities. Causality, however, cannot be shown, and the possibility exists that the posture was the result, rather than the cause, of the pain.

In the group of subjects studied, it is apparent that the ideal postural alignment described by Kendall and McCreary[8] was uncommon. Some persons might believe that we are being unrealistic in our standards and that ideal postural alignment must therefore be redefined based on what is observed as common. We propose rather that therapists continue to strive for ideal alignment because the results of this study suggest that postural abnormality is associated with pain. The converse must also be considered, however, in that pain may also be the cause of poor postural alignment. Further studies are needed to clarify these issues.

This study establishes a relationship between severity of postural abnormality and incidence of pain in the cervical, thoracic, and shoulder regions. Further study is needed, however, to determine whether exercise can change posture and whether improving postural alignment can alter the incidence of pain. It is essential to establish what the relationships are between postural intervention and pain reduction in order to justify the common intervention of postural correction and exercise used in the clinic. Additional research in the area of quantifying postural abnormalities would also be beneficial in establishing what relationships do exist.

Conclusion

A high incidence of postural abnormalities (forward head=66%, kyphosis=38%, right rounded shoulder=73%, left rounded shoulder=66%) was observed in the TCS region in a group of healthy subjects between the ages of 20 and 50 years. A relationship between the severity of postural deviations and the severity and frequency of pain in the TCS region was not found. A significantly higher incidence of pain, however, was found in subjects with more severe postural abnormalities. Further research is warranted based on these findings.

Acknowledgments

We thank Carol Leiper, PhD, PT; Laurita Hack, PhD, PT; and Lori Griegel for their invaluable assistance in reviewing, editing, and providing input regarding statistical analysis for this manuscript. We also thank Jack V Morris, Jr, for his assistance and support.

References

1 Schwartz L. A resume, with comments, of the available literature relating to posture. *Public Health Rep.* 1927;42:1219–1248.

2 Forrester-Brown MF. Posture as a factor in health and disease. *Br Med J.* 1926;1:690–693.

3 Grossman J. Faulty postures in children. *Medical Review of Reviews.* 1918;24:708–726.

4 Hansson KG. Body mechanics and posture. *JAMA.* 1945;128:947–953.

5 Turner M. Posture and pain. *Phys Ther Rev.* 1957;37:294–297.

6 Kuhns JG. The late effects of minor degrees of poor posture. *Phys Ther Rev.* 1949;29:165–168.

7 MacEwan CG, Powell E, Howe EC. An objective method of grading posture: its development, routine procedure and applications. *Phys Ther Rev.* 1935;15:167–173.

8 Kendall FP, McCreary EK. Muscles: Testing and Function. 3rd ed. Baltimore, Md: Williams & Wilkins; 1983:112–113, 116, 270–315.

9 Brown LT. A combined medical and postural examination of 746 young adults. *Am J Orthop Surg.* 1917;15:774–787.

10 Klein A. What price posture training? *J Health Phys Ed Rec.* 1932;3:14, 54.

11 Singer KP. A new musculoskeletal assessment in a student population. *Journal of Orthopaedic and Sports Physical Therapy.* 1986;8:34–41.

12 Markel HH. Posture in its relation to health: etiology, mechanics, and treatment of faulty posture. *Phys Ther Rev.* 1929;9:209–210.

13 Lindstrom M. The effect of physical therapy on pathological postures with special regard to the cervical spine. *Phys Ther Rev.* 1957;37:292–293.

14 Osgood RB. Is there any evidence that poor posture bears any causal relation to poor health in children? *Phys Ther Rev.* 1923;3:18–24.

15 McCulloch H. Postural defects and body types in children. *Med Clin North Am.* 1925;9:99–108.

16 Little EM. Technique in treatment: the treatment of postural defects in children and adolescents. *Lancet.* 1925;1:197–199.

17 Robinson O. The physical therapist and the postural patient. *Phys Ther Rev.* 1929;9:211–212.

18 Russek AS. Diagnosis and treatment of scapulocostal syndrome. *JAMA.* 1952;150:25–27.

19 Lezberg SF. Posture of the head: its relevance to the conservative treatment of cervicobrachial radiculitis. *Phys Ther.* 1966;46:953–957.

20 Michele AA, Eisenberg J. Scapulocostal syndrome. *Arch Phys Med Rehabil.* 1968;49:383–387.

21 Michele AA, Davies JJ, Krueger FJ, Lichtor JM. Scapulocostal syndrome (fatigue-postural paradox). *NY State J Med.* 1950;50:1353–1356.

22 Mannheimer JS, Rosenthal RM. Acute and chronic postural abnormalities as related to craniofacial pain and temporomandibular disorders. *Dent Clin North Am.* 1991;35:185–208.

23 Enwemeka CS, Bonet IM, Ingle JA, et al. Postural corrections in persons with neck pain. *Journal of Orthopaedic and Sports Physical Therapy.* 1986;8(5):235–242.

24 Braun BL. Postural differences between asymptomatic men and women and craniofacial pain patients. *Arch Phys Med Rehabil.* 1991;72:653–656.

25 Horter TS. How to care for your neck. *Phys Ther.* 1978;58:184–185.

26 Haggart GE. Value of conservative management in cervicobrachial pain. *JAMA.* 1948;137:508–513.

27 Downie WW, Leatham PA, Rhind VM, et al. Studies with pain rating scales. *Ann Rheum Dis.* 1978;37:378–381.

28 Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics.* 1977;33:159–174.

Appendix. *Pain Questionnaire*

Name:
Gender: Male/Female
Occupation:
Age:
Handedness: Right/Left

Do you have a history of scoliosis or any other skeletal problems that you are aware of? If so, what are they?

Circle the numbers and letters below that best describe any pain you may experience during the day when at rest or during sitting, standing, or any activities (eg, running, typing). Circling "rarely" under frequency and "0" under severity will be equivalent to an answer of "never."

Frequency rating scores: R=rarely (1 time per month or less)
O=occasionally (2–3 times per month)
F=Frequently (1–3 times per week or more)

How often do you experience headaches? F O R

How would you rate the severity of this pain?
mild 0 1 2 3 4 5 6 7 8 9 10 severe

How often do you experience pain in the following regions, and how would you rate this pain?

Region[a]	Frequency	Severity[b]
A_1	F O R	mild 0 1 2 3 4 5 6 7 8 9 10 severe
A_2	F O R	mild 0 1 2 3 4 5 6 7 8 9 10 severe
B_1	F O R	mild 0 1 2 3 4 5 6 7 8 9 10 severe
B_2	F O R	mild 0 1 2 3 4 5 6 7 8 9 10 severe
C_1	F O R	mild 0 1 2 3 4 5 6 7 8 9 10 severe
C_2	F O R	mild 0 1 2 3 4 5 6 7 8 9 10 severe
D	F O R	mild 0 1 2 3 4 5 6 7 8 9 10 severe

[a] A_1=right pectoral region, A_2=left pectoral region, B_1=left posterior cervical region; B_2=right posterior cervical region, C_1=left shoulder region, C_2=right shoulder region, D=interscapular region.

[b] 0=no pain, 1–3=mild pain, 4–7=moderate pain, 8–10=severe pain.