Factors Affecting Shoulder Pain in Adolescents and Young Adults with Spina Bifida

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Purpose: This study was designed to determine whether factors affecting shoulder pain in adults with spinal cord injury also affected adolescent and young adult manual wheelchair users with spina bifida. **Methods:** Forty-one participants with spina bifida rated their pain using the Wheelchair User's Shoulder Pain Index. **Results:** Results showed no significant relationship between shoulder pain and age or duration of wheelchair use but significant differences in pain between age groups. Participation in a sports program and level of lesion were not factors in pain intensity. Propelling up an incline was the activity for which the highest intensity of pain was reported. **Conclusion:** Shoulder pain in adolescents and young adults with spina bifida is not as great as previously reported in adults with spinal cord injuries but older subjects had greater pain than younger subjects. **(Pediatr Phys Ther 2008;20:224–232)** *Key words: adolescent, adult, child, human movement system, shoulder pain/etiology spina bifida, wheelchairs*

INTRODUCTION

Physical therapists and other researchers have studied the presence of shoulder pain in individuals with spinal cord injuries (SCI) who use wheelchairs. The majority of subjects who participated in the studies were adults aged between 18 and 65 years who had an acquired SCI.[1–5] Factors that have been found to be associated with shoulder pain in wheelchair users are age, duration of wheelchair use, and type of activities of daily living (ADLs) performed. A literature review revealed that as age and length of time using wheelchairs increased so did shoulder pain in adults with SCI.[2,4–8] The literature review also showed that, as shoulder pain increased, the ability to complete transfers and ADLs decreased.[6,7,9] Neither participation in wheelchair athletics[2] nor the level of paraplegia in adults with SCI[3,7] has been found to be associated with wheelchair users' shoulder pain. The purpose of this study was to determine whether individuals with spina bifida showed similar degrees of shoulder pain and problems during wheelchair propulsion and ADLs as those that have been found in adult wheelchair users with SCI. The following research hypotheses were tested:

1. Pain level will increase with an increase in time (years) subjects self-propel their wheelchairs.
2. As the age of the subjects with spina bifida using manual wheelchairs increases, the level of pain will increase.
3. There will be no difference in pain between athlete wheelchair users and non-athlete wheelchair users.
4. There will be no difference in pain between wheelchair users who have thoracic level spina bifida and those who have lumbar or sacral level spina bifida.
5. Subjects will report that the ADL that causes the highest intensity of pain is pushing their wheelchair up an incline.

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METHODS

Design

This study was a descriptive research design using a survey instrument. It was conducted with the assistance of the Arkansas Spinal Cord Commission (ASCC). The survey instrument was the Wheelchair User's Shoulder Pain

Index (WUSPI)[10] and subjects were individuals 10 to 31 years old who have spina bifida. The study was approved by the Arkansas State University Institutional Review Board.

Sample

Subjects were volunteers registered through the ASCC who met the inclusion criteria of being between the ages of 10 and 31 years, having a diagnosis of spina bifida, and using a manual wheelchair. Because the ASCC database did not include primary method of locomotion, all registrants meeting the age and diagnostic criteria were recruited.

Instrumentation

The WUSPI was developed by Curtis et al[10] for use in studying chronic shoulder pain in individuals at least 18 years old who use wheelchairs as their primary means of mobility. Test-retest reliability of the WUSPI is high (intraclass correlation coefficient (1,1) = 0.99). Concurrent validity of the WUSPI was examined in relationship to goniometric measurements. The results showed a significant negative correlation between the total scores on the WUSPI and shoulder range of motion measurements of shoulder abduction ($r = -0.49$), flexion ($r = -0.48$), and extension ($r = -0.30$). The results showed that, although goniometry may have a strong diagnostic value (23.5% variance in total score on the WUSPI), it is limited in relationship to function because of other factors that influence the scores, such as shoulder impingement, overuse, and decreased strength in shoulder muscles.[8]

In addition to general demographic questions, the demographic part of the WUSPI also includes questions related to wheelchair use and functional activities. Modifications were made to make the survey better reflect the characteristics of the sample and gather data needed for this study. First, because the researchers were not present to answer questions while subjects were completing the WUSPI, instructions were added informing the subjects that they could ask their parents to help them if necessary. Second, questions concerning marital status and type of disability were deleted from the questionnaire, as they did not apply to this study. Third, the cervical level was deleted because the ASCC did not have any registrants with cervical lesions. Fourth, a third part of the question concerning type of wheelchair used was added to see if any subjects switched from a manual to a power chair due to shoulder pain. Finally, a question was added about whether subjects walked and, if so, how long per day, and whether they used any assistive device. Individuals who used a power wheelchair or walking as their primary means of locomotion were excluded from the study. The last two questions were needed to identify these individuals.

The medical history questionnaire includes questions about shoulder pain and which shoulder was affected. The only modification to this part was to add a question about what type of shoulder surgery subjects may have had and when it was performed.

Subjects reporting shoulder pain were asked to rate the intensity of their pain when performing certain activities (15 questions) in the past week. Subjects rated their pain by marking an "X" at the point on a 10 cm line that corresponded with their pain level. The ends of each line were anchored with the words "no pain" at the left end and "worst pain ever experienced" at the right end.

To compute the pain level, each line was measured with a ruler from the left end to the "X" and the sum of the levels reported for each question was calculated. Because subjects could mark "not performed" next to any activity, the sum was divided by the number of items completed and multiplied by 15 to give the performance-corrected score.[10]

Procedure

Two hundred fifty-four individuals who met the age and diagnostic criteria were mailed the questionnaire by the ASCC. Postage paid stamped envelopes to return the questionnaires were included. Subjects were asked to voluntarily give consent to participate in the study and were informed that their personal information would be confidential. The researcher did not have knowledge of personal information such as name, address, and telephone number. A reminder was sent out by ASCC 1 month before all questionnaires were to be returned to ask individuals who had not completed the form to please do so and mail the form back. One condition for access to the individuals in the database was that complete anonymity would be maintained and researchers would not contact subjects directly.

Data Analysis

Hypotheses 1 and 2 (H1 and H2) were analyzed by Pearson correlation coefficients to see if there was a relationship between the 2 variables; H1: time in wheelchair in years and pain (total WUSPI score) and H2: pain and age in years. Differences between athletes and non-athletes and between those with thoracic and lumbar/sacral lesions were analyzed using *t* tests with total WUSPI score as the dependent variable to determine group differences. An alpha level of $p \leq 0.05$ was considered statistically significant for these hypotheses. One-tailed values were used for the correlations and 2-tailed for the *t* tests. Hypothesis 5 was not tested for significance. The mean pain level for each ADL was calculated to determine the ADL leading to the highest intensity of pain.

After data analysis for the entire group, the same hypotheses were tested separately for subjects 10 to 18 years old and those older than 18 years. Because of the small numbers in each of these groups, relationships between pain and age and years in wheelchair were determined using Spearman's rho correlation coefficient. Differences between the athletic participation and lesion level groups were analyzed with the Mann-Whitney *U* test. Finally, the 2 groups' total pain scores were compared.

RESULTS

All questionnaires were mailed at the end of September 2005. Questionnaires returned by December 31, 2005

TABLE 1
Subject Characteristics for Sample and Age Groups—Continuous Variables

Variables	All Subjects				Subjects 10–18 yr				Subjects >18 yr			
	N	Min–Max	Mean	SD	N	Min–Max	Mean	SD	N	Min–Max	Mean	SD
Age (yr)	40*	10–31	20.75	5.99	13	10–18	14.23	2.62	27	19–31	23.89	4.37
Height (in.)	38	48–72	58.87	6.85	10	48–65	55.80	6.30	27	48–72	59.81	6.89
Weight (lbs)	40	56–250	127.80	49.85	12	56–155	106.17	30.53	27	77–250	135.48	53.32
Years self-propelling manual wc	40	0–31	15.76	7.23	13	8–15	11.62	2.50	26	0–31	17.44	7.91
Years using power wc	15	0–26	4.69	6.51	3	0–5	1.80	2.78	12	0.5–26	5.42	7.05
Hours sports/leisure activities per week	35	0–40	13.51	12.32	11	2–32	11.09	8.72	24	0–40	14.63	13.68
Average transfers per day	38	0–30	9.26	7.92	12	1–30	11.17	9.36	25	0–28	8.40	7.34
Hours spent driving per week	8	1–15	7.06	4.97	0				8	1–15	7.06	4.97

* One subject did not report age.
N indicates number of participants; wc, wheelchair.

were included in the data analysis. Sixty-one of 254 (24%) subjects participated in this study by returning the mailed questionnaires. Of the 61 subjects 20 were excluded. Eleven of the subjects excluded did not meet the criteria for the study because they walked exclusively with or without assistive devices and 8 of these subjects reported shoulder pain. Seven questionnaires were not properly filled out by subjects who used wheelchairs, but 5 of these subjects reported shoulder pain by using descriptive words such as very mild, mild, or a lot of pain; burning, cramping, achy, and discomfort. Two questionnaires were returned without being filled out, both with comments that the study did not apply to them. Forty-one subjects (16%), 23 women and 18 men, in an age range of 10 to 31 years with a mean age of 21 years participated in this study.

Mann-Whitney *U* comparisons of demographic data between the 41 subjects who completed the WUSPI and the 7 subjects who used descriptors instead of marks on the scale showed that the 2 groups did not differ significantly on any continuous variable except number of hours per week participating in sports/leisure activities. The 35 subjects in the complete group who responded to that item reported 13.51 ± 12.33 hours per week, whereas the 7 in the descriptor group participated 4.86 ± 8.99 hours per week ($U = 58.5$, $p = 0.030$).

Data for nominal variables were difficult to analyze because at least one cell in each χ^2 analysis had an expected count of less than 5. For each of the variables, the proportion of subjects selecting each option was similar in the 2 groups except for 3 variables. Two of 12 subjects who had complete questionnaires reported that they switched from a manual wheelchair to a power wheelchair because of shoulder pain; both of the subjects in the descriptor group who switched from manual to power wheelchair use did so due to shoulder pain. Six of 13 subjects in the complete group reported using a wheelchair most of the time with little walking and the other 7 reporting equal walking and wheelchair use or walk more than use a wheelchair, whereas all 7 of those in the descriptor group reported using a wheelchair most or all of the time. Finally, 6 of 41 of the subjects with complete questionnaires reported participating in a sports program and none of the 7 who used descriptors reported participating in a sports program.

Tables 1 to 4 include the descriptive statistics for the sample. One subject did not report his age so numbers of subjects with each characteristic within age groups may not add up to the total number of subjects with that characteristic. All ages within the range were fairly well represented with between 1 and 6 subjects at 19 of the 22 ages and none at the other 3 ages. Age, height, hours spent driving, and number of hours of school or work per day resulted in no significant skew. The other demographic variables (weight, years using a power wheelchair, hours participating in sports/leisure activities per week, and average transfers per day) were significantly positively skewed. Overweight/obese determinations were based on subject report only with no independent verification requested. None of the subjects had undergone surgery on their shoulders. For all items on the WUSPI, the majority of subjects who indicated performing the task reported no pain. As a result, all items showed a significant positive skew.

Hypothesis 1 stated that as years spent in wheelchair increased, the report of pain as measured by WUSPI would also increase. The correlation between wheelchair years and pain was $r = 0.072$ (n = 40, NS). For subjects 10 to 18 years of age, $\rho = 0.489$ (n = 13, NS) and for those older than 18 years, $\rho = 0.029$ (n = 26, NS).

Hypothesis 2 stated that as the age of a person with spina bifida who uses a wheelchair increased, the report of pain as measured by the WUSPI would also increase. The correlation between age and pain was $r = 0.198$ (n = 40, NS). For subjects 10 to 18 years of age, $\rho = 0.305$ (n = 13, NS) and for those older than 18 years, $\rho = 0.099$ (n = 27, NS).

Hypothesis 3 stated that there will be no significant difference in pain level between wheelchair users who participated in a sports program and those who did not participate in a sports program. Those who participated in sports (n = 6) had less pain than those who did not (n = 35) (0.59 vs 12.31, $t = 0.795$, NS) and hypothesis 3 was accepted. The same results were found for those 10 to 18 years of age (yes = 5, no = 8) (0.71 vs 2.79, U = 17, NS). For those older than 18 years, only 1 subject participated in a sports program and reported no pain. The mean pain level for the 26 subjects who did not participate in a sports program was 15.71.

TABLE 2
Subject Characteristics for Sample and Age Groups—Discrete Variables

Variables	N		
	All*	10–18 yr	>18 yr
Gender	41	13	27
Female	23	7	16
Male	18	6	11
Overweight	41	13	27
Yes	15	3	11
No	26	10	16
Obese	39	12	26
Yes	6	0	5
No	33	12	21
Switched from manual to power due to shoulder pain	12	2	10
Yes	2	1	1
No	10	1	9
Walk	41	13	27
Yes	13	3	10
No	28	10	17
Use braces	14	3	11
Yes	12	3	9
No	2	0	2
Type of assistive device	13	3	10
None	1	0	1
2 axillary crutches	2	1	1
2 forearm crutches	7	2	5
Orthosis	3	0	3
Time walking vs. ws	13	3	10
Walking most, wc little	5	0	5
Equal walk/wc	2	1	1
WC most time; walk little	6	2	4
Lesion level	32	12	19
Thoracic	9	4	5
Lumbar	22	8	13
Sacral	1	0	1
Participation in sport program	41	13	27
Yes	6	5	1
No	35	8	26
Dominant hand	41	13	27
Left	12	2	10
Right	25	8	16
Both equally	4	3	1
Occupation	39	13	25
Student	21	13	7
Volunteer	3	0	3
Other	15	0	15
Drive	41	13	27
Yes	8	0	8
No	33	13	19
Vehicle used (all subjects who drove were over 18)	9		
Car	4		
Van with lift	6		
Other	5		

* One subject did not report age so number of subjects in each age group may not add up to the total number of subjects.
N indicates number of participants; wc, wheelchair.

Hypothesis 4 stated that there will be no difference in the level of pain as measured by the WUSPI and the level of injury to the spinal cord. Nine subjects reported a thoracic lesion level and 23 reported a lumbar or sacral lesion level; the remaining 9 subjects either did not know the region of their lesion or marked more than one of the areas. Actual spinal level of lesion was left blank on almost all questionnaires. Subjects with thoracic lesions had less pain than those with sacral or lumbar lesions (5.61 vs 12.21, t = 0.688, NS) and Hypothesis 4 was accepted although the pain pattern was different in the 2 age groups. Subjects 10 to 18 years of age with thoracic lesions (n = 4) had more pain than those with lumbar lesions (n = 8) (4.77 vs 0.85, U = 12, NS). Subjects older than 18 years with thoracic lesions (n = 5) had less pain than those with lumbar or sacral lesions (n = 14) (6.29 vs 19.59, U = 28.5, NS).

TABLE 3
Shoulder Health History Descriptive Statistics

Variables	N		
	All*	10–18 yr	>18 yr
Shoulder pain before wc use			
Yes	5	0	5
No	31	12	18
Which shoulder?			
Left	0		0
Right	2		2
Both	3		3
Shoulder pain since wc/brace			
Yes	21	6	14
No	17	7	10
Which shoulder?			
Left	3	3	0
Right	4		4
Both	13	3	9
Surgery on shoulder			
Yes	0	0	0
No	40	13	26
Current shoulder pain			
Yes	12	3	8
No	28	10	18
Which shoulder?			
Left	2	2	0
Right	2	1	1
Both	8	2	7
Sought medical attention for shoulder pain			
Yes	12	2	10
No	26	10	15
Physician	9	2	7
Physical therapy (PT)	1	0	1
Other	1	0	1
Physician and PT	1	0	1
Relief used			
None	2	0	2
Medication	1	0	1
Rest	2	2	0
2 or more listed	2	0	1
3 or more listed	13	4	9
Pain affected usual activities during past week			
Yes	5	1	4
No	32	11	20
Had hand/wrist/elbow pain			
Yes	19	5	14
No	20	8	11

* One subject did not report age.
N indicates number of participants; wc, wheelchair.

Hypothesis 5 stated that propelling a wheelchair up a ramp or incline would have the highest mean pain level. Figure 1 shows the mean pain levels for all subjects on each ADL and the hypothesis can be accepted for the entire group and for subjects older than 18 years. For those 10 to 18 years of age, loading a wheelchair in the car had a higher mean score (0.55) than pushing a wheelchair up an incline (0.52). However, only 4 subjects 10 to 18 years of age performed the task and 3 of them had no pain with the task so the mean is an indication of pain in 1 subject. Twenty-one of 28 subjects over 18 years of age propelled their wheelchair up an incline and 9 reported pain.

Subjects older than 18 years had significantly higher pain than subjects 10 to 18 years of age (15.13 ± 29.18 vs 1.99 ± 4.51) ($t = 2.28$, $p = 0.030$).

DISCUSSION

Shoulder pain in individuals who use wheelchairs as their primary means of locomotion can be detrimental to their independence. The subjects participating in studies investigating different factors contributing to shoulder pain in wheelchair users have been adults with traumatic SCI.[1–7,9] The participants in this study were born with spina bifida and used a wheelchair for their primary means of locomotion. In contrast to studies on only wheelchair users

TABLE 4
Pain Level During Performance of Activities of Daily Living

Activity	N	N with No pain	% with Pain	Max	Mean	SD
Transferring bed to wc	31	25	19	7.60	0.57	1.55
Transferring wc to car	26	20	23	7.60	0.76	1.75
Transferring wc to tub/shower	26	21	19	7.60	0.67	1.74
Loading wc into car	12	10	17	2.60	0.44	0.97
Pushing wc 10 min or more	30	21	30	9.00	1.12	2.19
Pushing wc up ramps/inclines outdoor	34	20	41	9.00	1.67	2.50
Lifting object down from overhead shelf	23	19	17	7.60	0.80	1.84
Putting on pants	30	26	13	2.70	0.21	0.57
Putting on t-shirt	38	29	24	9.60	0.37	1.58
Putting on button down shirt	33	29	12	8.50	0.39	1.50
Washing back	26	22	15	2.60	0.30	0.74
Usual daily activities at school/work	35	28	20	8.10	0.65	1.61
Driving	16	15	6	2.60	0.14	0.60
Performing household chores	33	17	48	7.70	0.89	1.84
Sleeping	38	29	24	9.10	0.74	1.69
Totals	41	26	37	124.65	9.19	24.83

N indicates number of participants performing the task; wc, wheelchair.

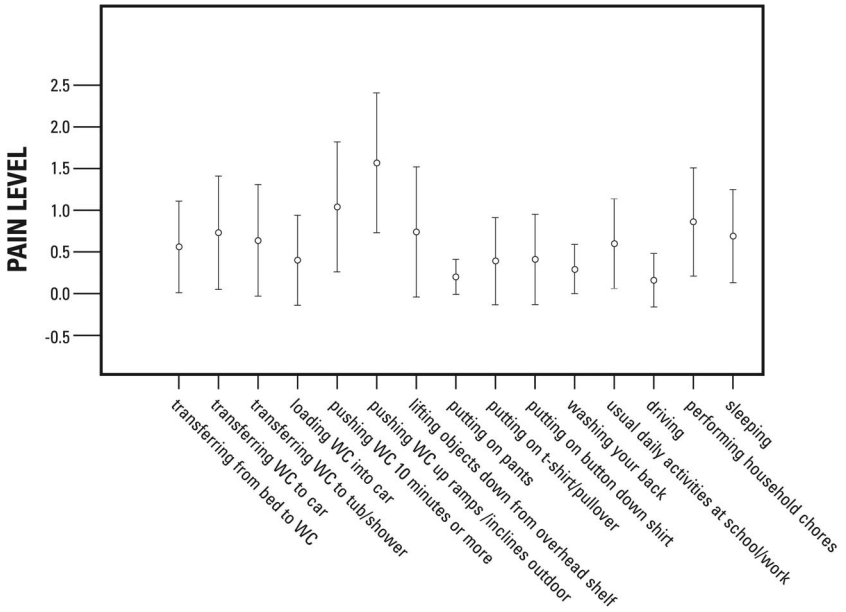

Fig. 1. Pain levels during activities of daily living, mean values of WUSPI ±2 SE. WC indicates wheelchair.

who began using a wheelchair as an adult that investigated the relationship between age and pain level or years of wheelchair use and pain level, our results showed no significant relationship with either variable in either age range.

Boninger et al[1] studied 28 subjects with a mean age of 35 years, 9 (32%) of whom had shoulder pain during the previous month. Their results showed no significant difference in age between those who reported pain in the last month and those who did not. A comparable percent of subjects in our study had shoulder pain with 30% of the entire group, 16% of those 10 to 18 years of age, and 33% of those over 18 years of age reporting current pain.

Subjects in the study by Dalyan et al[5] had an average age of 42 years and those experiencing upper extremity pain were significantly older than those who did not experience pain. They found no differences in prevalence of pain based on gender, completeness of lesion, or paraplegia versus tetraplegia. The current study also investigated age and pain level and found no significant relationship overall or within each age group but showed that subjects older than 18 years had significantly higher pain levels than those 10 to 18 years of age. Subjects in our study who currently had pain were 21.01 ± 6.03 years old and those who did not were 19.88 ± 6.04 years old. Two reasons could account for the differences in the results of the two studies. First, Dalyan et al did not limit their analyses to subjects with shoulder pain. While 71% of their subjects with pain had shoulder pain, the remaining 39% had elbow, wrist, or hand pain. The second reason for the differ-

ence could be the age of the subjects studied. Dalyan et al found the greatest contribution to the differences in age between those with and without pain was that 42% of those reporting pain were 31 to 40 years old compared with 24.5% of those without pain in the same age group. Only 5 of our subjects fell within this age group and all were 31 years old.

Although we found no significant linear relationship between pain level and age or years of wheelchair use, we did find that subjects older than 18 years reported significantly higher pain levels than those 10 to 18 years of age. The older subjects may be beginning to experience typical age-related differences of decreased bone density, tendon and ligament stability, lubrication of joints, and other biomechanical changes.[11] Almekinders[12] noted that rotator cuff tendinitis can be found in upper extremity athletes as early as the third decade, the age of the older subjects in our study. Lal investigated changes in the shoulder complex in subjects with SCI using radiography and found that 38 of 53 subjects developed changes, but only 6 reported shoulder pain. The results also showed that 35 of the subjects with degenerative changes were in the older age range (>30 years) and 3 were in the younger age range. All 3 subjects were 25 to 29 years of age; no subjects 19 to 24 years of age showed degenerative changes. They found that degenerative changes were noted as early as 4 years after injury.[4] The age-related differences combined with years of wheelchair use may have led to increased pain in both our older subjects and those in other studies.

Sawatzky et al[13] also used the WUSPI to investigate the difference between adult onset wheelchair users and childhood onset wheelchair users and found that shoulder pain was higher in the adult onset wheelchair users (18.8 $\pm$ 20.1) than the childhood onset wheelchair users (7.6 $\pm$ 10.5). Twenty-five of the 31 subjects in the childhood onset wheelchair user group had spina bifida. The mean pain level of subjects older than 18 years in our study, computed using the same method as Sawatzky et al, indicated that our subjects had slightly more pain than their childhood onset wheelchair users (10.3 $\pm$ 19.8). Our subjects were an average of 1.6 years older (22.3 $\pm$ 6.3 vs 23.9 $\pm$ 4.4) and had used a wheelchair an average of 2 years longer (15.3 $\pm$ 7.9 vs 17.4 $\pm$ 7.9) than their subjects.

Sawatzky et al[13] hypothesized a number of reasons why pain was less in their subjects who were childhood onset wheelchair users than in subjects in their study and others who began using wheelchairs as adults. One hypothesis was that tissue remodeled similar to remodeling found in individuals with proximal femoral focal deficiency[14] and obstetric brachial plexus.[15] A second reason could be adaptations in wheelchair propulsion patterns that decrease loads on the shoulder and lessen pain.

Sawatzky et al[13] also noted that childhood onset wheelchair users may have had more assistance when they first began using a wheelchair than adult onset wheelchair users. They discovered that only 35.5% of their subjects with childhood onset drove a car compared with 77.3% of those with adult onset. A slightly lower percentage (29.6%) of the subjects older than 18 years in our study drove a car. This may be an indication of an overall decreased activity level. Brown and Gordon[16] compared activity levels of children with disabilities between 6 and 19 years of age (33% of whom had spina bifida) with those of matched controls. They found that the children with disabilities participated in 3 times the number of activities requiring assistance with 4 times the amount of time per day in such activities as non-disabled children. If subjects received help in performing some or all of the tasks, that could have decreased their pain levels and masked results that may have been significant if all subjects were performing all tasks independently.

The lack of significant relationships could also be due to some subjects' apparent difficulty in filling out the WUSPI. This was seen in questionnaires excluded because subjects wrote descriptions of their pain and did not place an X on the line; other subjects wrote numbers on the line indicating their pain during the activity that did not correlate with the measurement. Questionnaires were included as long as the subject indicated using a manual wheelchair and had completed the WUSPI in the correct manner, even though some of those questionnaires had questionable data. Two subjects who indicated on the medical history form that they currently had shoulder pain marked no pain for any item on the WUSPI, and 6 subjects who indicated in the medical history that they had no shoulder pain marked a pain level for various ADLs. In addition, some subjects may not have understood the difference between "do not perform" and "no pain"; 3 subjects indicated that they "do not perform" sleeping. Others indicated shoulder pain with an ostensibly more difficult task such as wheeling up a ramp while simultaneously indicating that they did not perform easier tasks such as putting on a button down shirt. This could indicate that those subjects only marked the tasks on which they experienced pain. No cognitive testing was completed on or available for subjects who participated. The researchers and their partners at ASCC had discussed the use of the visual analog scale as a potential problem but, after consultation with Curtis, opted not to make changes because validity and reliability had been determined using the line. It may be beneficial to replicate this study using a different instrument than the WUSPI or a modification of the WUSPI that is reliable and valid with subjects younger than 18 years and individuals with spina bifida to see if the results correspond to those found in this study.

The hypothesis that participation in sports programs would have no effect on shoulder pain was accepted and results showed that some subjects from both groups reported shoulder pain. The problem with generalizing the results is that only 6 subjects reported participation in a sports program. According to the ASCC, very few sports programs are offered to this population in the small cities and towns where subjects live in. Researchers studying adult subjects with SCI also reported that participation in sports or sport programs did not seem to be a factor in whether subjects reported shoulder pain. Finley and Rodgers[2] investigated whether non-athletic wheelchair users

had more shoulder pain than athletic wheelchair users and found no difference between the groups.

The level of SCI was thought not to play a role in the presence of shoulder pain. Several studies have investigated whether higher level injuries result in a higher level of shoulder pain than lower level injuries and found no differences. Sinnott et al[3] investigated upper-level and lower-level paraplegia to determine any difference in ADLs and shoulder pain. They found significant differences in reports of difficulty in performing tasks with subjects with the high-level lesions reporting greater difficulty but no difference between the groups in presence of pain; pain level differences were not reported. Curtis et al[7] also investigated tetraplegia, paraplegia, and the prevalence of shoulder pain. They found that prevalence and intensity were higher in tetraplegia but both groups reported shoulder pain. The current study investigated the level of shoulder pain by lesion level (thoracic vs lumbar/sacral) and found results similar to those of Sinnott et al[3] with no difference between groups either in level of pain or in percentage of subjects reporting current pain (37.5% of subjects with thoracic lesions vs 34.8% of those with lumbar/sacral lesions reported pain). The greater prevalence and intensity of pain seen in the study by Curtis et al[7] in subjects with tetraplegia may be due to upper extremity weakness.[5] The results of our study cannot be generalized since only 9 subjects reported a thoracic lesion level. Also, some subjects' data were excluded from this analysis because they marked both thoracic and lumbar for level of lesion.

Shoulder pain seems to be a factor in the ability of many individuals with SCI to complete their ADLs. Curtis et al analyzed their surveys to determine for which ADL from the WUSPI their subjects reported the highest pain level. The results showed that both subjects with tetraplegia and paraplegia reported that shoulder pain intensity was higher while pushing their wheelchairs up an incline, pushing for more than 10 minutes, and while sleeping.[7] Pentland and Twomey studied 11 able-bodied women and 11 women with paraplegia using a questionnaire and the results showed that pain was reported "usually or always" during outdoor wheeling. They investigated which ADL subjects would report as resulting in the highest intensity of shoulder pain.[8]The results showed that propelling the wheelchair up an incline or ramp had the highest level of pain based on total scores and our results match earlier studies.

Shoulder pain may not be as prevalent in the population of adults with spina bifida as that reported in studies investigating adults with SCI. However, since individuals with spina bifida are living longer, further research is needed to study this population of individuals to see whether their pain increases as they reach the age of subjects participating in other studies. Also, research is needed comparing individuals with spina bifida and adults with SCI to see the difference between the 2 groups and if adaptations are playing an important role in the lower level of shoulder pain reported in individuals with spina bifida.

Limitations

The small return rate of questionnaires is a limitation of the study. The reason for the lack of return of more questionnaires is unknown although several reasons can be hypothesized. Some of the subjects may have walked all the time and did not return it because they did not use a wheelchair. Others may not have returned the questionnaires because they had the same difficulty in completing them as those who returned them but filled them out incorrectly. Still others may not have returned them because they had no pain and thought their questionnaires would not be used.

CONCLUSIONS

Individuals with spina bifida do not show the same level of shoulder pain as individuals with acquired SCI in adulthood after a similar number of years of wheelchair propulsion. Subjects older than 18 years had greater pain than those 10 to 18 years of age. Further investigation is needed to determine the reason why the pain level is lower and whether pain increases with increasing age. These conclusions are preliminary due to apparent difficulties in our subjects' ability to complete the questionnaire.

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