[Primary Care]

A Shoulder Health Survey: Correlating Behaviors and Comorbidities With Shoulder Problems

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Shoulder pain and loss of shoulder function are common complaints reported by a variety of patients. This article suggests that shoulder pain and loss of function are directly proportional to lifestyle choices, including smoking and obesity. To investigate possible relationships between lifestyle choices and shoulder health, the authors conducted an online survey combining the Oxford Shoulder Questionnaire, the Shoulder Rating Questionnaire, and the Subjective Shoulder Rating System. Data were collected from 166 respondents. Statistical significance was set at $P < .05$. The data show a statistically significant correlation between decreased shoulder function and cigarette smoking and a similar correlation between decreased shoulder function, elevated cholesterol, and obesity.

Keywords: shoulder; pain; smoking; alcohol

Shoulder pain and loss of shoulder function are common complaints reported by patients over a range of activity levels and ages. Incidence and point prevalence of shoulder pain in the general population range from 0.9% to 2.5% and 6.9% to 26%, respectively.⁹ Age (ie, older) and a history of shoulder injuries seem to be most predictive of shoulder pain. However, many patients have no obvious predisposing factors to the onset of shoulder discomfort or functional loss. Given the prevalence of shoulder complaints, we can reasonably hypothesize that lifestyle choices have some effect on overall shoulder health. In an effort to determine whether an association exists between shoulder problems and lifestyle choices, physicians at the shoulder division of the University of Texas Medical Branch and the University of Missouri School of Medicine, Departments of Orthopaedic Surgery, devised an online shoulder health survey. The purpose of this survey was to identify possible associations between controllable behaviors and shoulder health. If an association between lifestyle and shoulder function could be shown, then behavioral modifications may be able to prevent some types of shoulder pathology and thereby improve a patient's shoulder health and quality of life.

MATERIALS AND METHODS

Hypothesis

A direct relationship exists among negative lifestyle choices, shoulder pain, and loss of function.

Shoulder Questionnaire

The survey combined 3 previously used and validated patient-response shoulder surveys: the Oxford Shoulder Questionnaire,⁶ the Shoulder Rating Questionnaire,⁶ and the Subjective Shoulder Rating System.^{1,2,7} These surveys, along with others that were considered,^{3,4,10,11,13-16} provide a subjective assessment of shoulder function. The current survey also collected information regarding perceived active range of motion (using picture examples for guidance, as seen in Figure 1) as well as epidemiologic information, such as age, gender, race, and hand dominance. Tobacco and alcohol habits were registered, as were the participant's current level of activity, workout habits, past and present involvement in a variety of sports, occupation, and any current medical conditions.² Previous shoulder injuries and shoulder surgeries were also noted (Figure 2).

Study Population

The voluntary survey was administered online and made available to random visitors to the 2 institutions' respective Web sites. Data were collected between 2007 and 2008. Participants elected to follow the provided link and answer the survey questions. In sum, 166 surveys were collected, and the usable results were analyzed by a biostatistician.

Statistical Analysis

For dichotomous explanatory variables, a 2-sample *t* test was used to test for significant differences in 3 outcome vari-

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53. Indicate the maximum motion you are able to achieve with the indicated arm.

Figure 1. Picture guide for shoulder range of motion.

A

1. Age

- ☐ 10 - 15 ☐ 21 - 30 ☐ 41 - 50 ☐ 61 - 70 ☐ Greater than 80
☐ 16 - 20 ☐ 31 - 40 ☐ 51 - 60 ☐ 71 - 80

2. Gender

- ☐ Male ☐ Female

3. Hand dominance

- ☐ Right ☐ Left

4. If you have any shoulder problems at all, which side is problematic?

- ☐ Right ☐ Left ☐ Both ☐ Not Applicable

5. Do you smoke?

- ☐ Yes ☐ No

6. If you smoke, how many packs per day?

- ☐ Not applicable ☐ 0 - 1 ☐ Greater than 1, less than 2 ☐ Greater than 2, less than 3 ☐ Greater than 3

How long have you smoked?

- ☐ 0 - 1 year ☐ 1 - 2 years ☐ 2 - 5 years ☐ 5 - 10 years ☐ 10 - 15 years ☐ Greater than 15 years

7. Did you play or do you play?

- ☐ Little league football ☐ High school football ☐ Professional football
☐ Junior or intermediate school football ☐ College football ☐ Not applicable

8. What kind of work have you primarily done in your life?

- ☐ Sedentary (no lifting or occasional lifting of light objects) ☐ Active (frequent lifting of heavy objects)
☐ Normal (occasional lifting of light to moderately heavy objects) ☐ Strenuous (constant lifting of heavy objects)
☐ Moderately active (occasional lifting of heavy objects)

9. Do you workout with upper body weights?

- ☐ Never ☐ Twice a week ☐ More than three times per week
☐ Once a week ☐ Three times a week

10. Have you ever sustained a shoulder injury that prevented you from working or participating in activities of daily living or recreation?

- ☐ Yes ☐ No

Figure 2. A, survey questions, 1-10; B, survey questions, 11-18; C, shoulder pain-related questions.

B

11. Have you ever had shoulder surgery?
☐ Yes ☐ No

Reason for surgery:

☐ Dislocation ☐ Stiffness ☐ Unknown
☐ Rotator cuff tear ☐ Shoulder replacement Other: _____
12. Do you drink alcoholic beverages?
☐ Yes ☐ No
13. How much alcohol do you drink per week?bottles of beer: ☐ None ☐ 1 - 2 ☐ 3 - 5 ☐ Greater than 5mixed drinks: ☐ None ☐ 1 - 2 ☐ 3 - 5 ☐ Greater than 5glasses of wine: ☐ None ☐ 1 - 2 ☐ 3 - 5 ☐ Greater than 5**14. Nationality or race:**
☐ White Caucasian ☐ Asian ☐ Pacific Islander
☐ African American ☐ American Indian ☐ Middle Eastern
☐ Hispanic ☐ Indian Other: _____
15. Do you or have you regularly participated in any of the following athletics or sports (at least once per week for a period of 1 year)?
☐ Football ☐ Boxing ☐ Rugby ☐ Baseball
☐ Archery ☐ Golf ☐ Gymnastics ☐ Diving
☐ Tennis ☐ Martial Arts ☐ Fencing ☐ Not applicable
☐ Volleyball ☐ Rowing ☐ Weightlifting ☐ Track & Field throwing events (javelin, discus, shot-put)
☐ Swimming ☐ Skiing/Snowboard ☐ Basketball
☐ Cricket ☐ Softball ☐ Bowling Other: _____
16. If you participated in Football, Baseball, or Fast pitch softball, were you a:
☐ Pitcher ☐ Quarterback ☐ Not Applicable
☐ Lineman ☐ Linebacker Other: _____
17. You are currently employed or worked more than 10 years as a:
☐ Dookworker ☐ Teaching ☐ Janitorial ☐ Nurse
☐ Carpenter ☐ Research ☐ Truck Driver ☐ Medical
☐ Plumber ☐ Secretarial ☐ Police ☐ Musician - instrument
☐ Construction ☐ Administrative ☐ Pilot ☐ Not applicable
☐ Landscaping ☐ Professional (MD, JD, PhD, etc) ☐ Computer/Information Svc Other: _____
☐ Marine ☐ Sales ☐ Housewife, Househusband
18. Do you suffer from any of the following medical conditions?
☐ High blood pressure ☐ Peripheral vascular disease ☐ Liver Disease
☐ Elevated cholesterol ☐ Diabetes requiring insulin ☐ Cancer
☐ Heart Disease ☐ Diabetes not requiring insulin ☐ Obesity
☐ Lung Disease ☐ Parkinson's Disease ☐ Not Applicable
☐ Kidney Disease ☐ Rheumatoid Arthritis Other: _____

C

19. How would you describe the worst pain from your shoulder?
☐ Unbearable ☐ Severe ☐ Moderate ☐ Mild ☐ None
31. During the past month, how would you describe the usual pain in your shoulder at rest?
☐ Very Severe ☐ Severe ☐ Moderate ☐ Mild ☐ None
34. During the past month, how often have you had severe pain in your shoulder?
☐ Every day ☐ Several days per week ☐ One day per week ☐ Less than one day per week ☐ Never

Figure 2. (continued)

Table 1. Five outcome variables measured.^a

Outcome Variable	MIN	MAX	n	Mean ± SD	Score Correlation
SSRS	19	100	166	75.42 ± 3.07	Higher score, better outcome
SRQ	19	100	164	72.23 ± 18.55	Higher score, better outcome
OSQ	12	60	166	25.42 ± 9.84	Higher score, worse outcome
MPML	0	16	136	11.55 ± 3.22	Higher score, better outcome
MPMR	0	16	136	11.47 ± 3.07	Higher score, better outcome

^aSSRS, Subjective Shoulder Rating System; SRQ, Shoulder Rating Questionnaire; OSQ, Oxford Shoulder Questionnaire; MPML, maximum possible motion—left; MPMR, maximum possible motion—right

ables; Shoulder Rating Questionnaire, Oxford Shoulder Questionnaire, and Subjective Shoulder Rating System, separately. Equal or unequal variance between 2 groups was assumed on the basis of an *F* test and applied to a 2-sample *t* test. For explanatory variables with more than 2 categories, a 1-way analysis of variance was used. When significant differences in each outcome variable were found among multiple groups (such as work pattern and problematic side of shoulder), then multiple pairwise comparisons of means were performed on the basis of the Tukey-Kramer multiple-test procedure. A nominal significance level was set as .05 for all tests, and analyses were conducted using SAS 9.1.

Data Collection

There were 5 outcome variables, as listed in Table 1. The scores for the maximum possible motions of the left shoulder and right shoulder (MPML and MPMR) in Table 1 were the sum of the maximum abduction, forward flexion, internal rotation, and external rotation scores (point scale of 1-4, with a higher score indicating more motion).

In addition, 12 explanatory variables with 2 subquestionnaires were considered—namely, age, gender, hand domain, problematic side (shoulder), smoking (packs per day), work pattern, regular upper body workout, shoulder injury, shoulder surgery, drinking (drinks per week), race, and medical conditions (including hypertension, hypercholesterolemia, and obesity). Questions related to shoulder pain were found in responses 19-22 and 31-34, with a 5-point analogue scale (1-5, with *no pain* being a response of 5).

RESULTS

Subjective Shoulder Rating System

In a comparison of the Subjective Shoulder Rating System data and other variables, a statistically significant difference was associated with several groups of responses. Associations of note included the relationship between smoking, elevated

cholesterol, and obesity with shoulder dysfunction (Table 2). Smokers (n, 30) had a mean Subjective Shoulder Rating System score of 68.43 compared with nonsmokers (n, 133) with a mean score of 78.70 (*P* = .005) (Figure 3). Participants with known elevated cholesterol levels (n, 32) had a mean score of 71.063, compared with 78.214 in those without elevated cholesterol (n, 131) (*P* = .049). In addition, obese patients (n, 18) had a mean score of 66.556 versus nonobese patients (n, 145), who had a mean score of 78.083 (*P* = .011) (Figure 4). The validity of the questionnaire was supported by significantly lower shoulder function scores in individuals claiming previous shoulder injury or shoulder surgery, compared with those reporting no such injury or surgery. Interestingly enough, left-handed individuals (n, 22) had a significantly decreased mean score (66.96) compared with right-handed individuals (78.43; n, 127) (*P* = .007). Finally, of individuals who reported drinking mixed alcoholic drinks, the mean score of those drinking more than 2 drinks per week (n, 10) was significantly lower than that of those drinking 1 to 2 drinks per week (n, 26): 61.7 versus 83.54, respectively (*P* = .014). Of note, no difference existed between reported drinkers and nondrinkers.

Shoulder Rating Questionnaire

As with the Subjective Shoulder Rating System, those with shoulder injury or surgery showed statistically significant relative decreases in score, thereby supporting the validity of the Shoulder Rating Questionnaire. As in the Subjective Shoulder Rating System, smokers (n, 30) had a significantly lower mean score (62.08) than that of nonsmokers (74.50; n, 134) (*P* = .0008) (Figure 3). Furthermore, those undergoing a moderate workout pattern had higher scores than did those who are sedentary and those who undergo strenuous workouts (*P* = .0001) (Table 3). Interestingly, those who stated that they drink alcohol in general (n, 90) had a significantly increased mean score (75.61), as compared with those who do not drink (68.08; n, 73) (*P* = .012). As with the Subjective Shoulder Rating System scores, the average Shoulder Rating Questionnaire score of those who drink 1

Table 2. Association between Subjective Shoulder Rating System and explanatory variables (univariate, $n < 166$).

Explanatory Variable	n	Mean $\pm$ SD ^a	P
Q3. Hand domain			
Left	22	66.96 $\pm$ 20.83	.007
Right	127	78.43 $\pm$ 17.71	
Q4. Problematic side of shoulder			
Both	37	66.78 $\pm$ 19.13	.01
Left only	37	77.16 $\pm$ 17.57	
Right only	63	76.90 $\pm$ 15.83	
Multiple pairwise comparisons ^b			
Left only–both		(0.871, 19.885)	
Right only–both		(1.625, 18.614)	
Q5. Smoking			
Yes	30	68.43 $\pm$ 20.68	.005
No	133	78.70 $\pm$ 17.38	
Q6. Packs per day			
< 1	19	73.32 $\pm$ 21.37	.089
1-3	11	60.00 $\pm$ 17.19	
Q8. Work pattern			
Strenuous	7	67.71 $\pm$ 19.69	.093
Active	26	71.70 $\pm$ 17.01	
Moderate	33	80.00 $\pm$ 16.53	
Normal	57	82.83 $\pm$ 18.88	
Sedentary	30	76.42 $\pm$ 18.47	
Q10. Shoulder injury			
Yes	56	72.93 $\pm$ 19.77	.034
No	107	78.84 $\pm$ 14.87	
Q11. Shoulder surgery			
Yes	15	67.53 $\pm$ 14.72	.04
No	148	77.75 $\pm$ 18.52	
Q12. Drinking			
Yes	90	78.48 $\pm$ 15.34	.22
No	73	74.75 $\pm$ 21.53	

(continued)

Table 2. (continued)

Explanatory Variable	n	Mean $\pm$ SD ^a	P
Q13A. Bottles of beer per week			
1-2	31	80.80 $\pm$ 13.93	.17
> 2	26	75.00 $\pm$ 17.25	
Q13B. Number of mixed drinks			
1-2	26	83.54 $\pm$ 12.64	.014
> 2	10	61.70 $\pm$ 22.32	
Q13C. Glasses of wine per week			
1-2	26	77.27 $\pm$ 16.37	.12
> 2	16	68.13 $\pm$ 20.33	
Q18. Medical conditions			
High blood pressure			
Yes	39	69.077 $\pm$ 22.509	.23
No	127	79.242 $\pm$ 16.266	
Elevated cholesterol			
Yes	32	71.063 $\pm$ 20.837	.049
No	131	78.214 $\pm$ 17.560	
Obesity			
Yes	18	66.556 $\pm$ 20.004	.011
No	145	78.083 $\pm$ 17.860	

^aEstimated standard deviation.^bSimultaneous 95% confidence intervals based on the Tukey-Kramer test procedure (significance level, .05).

to 2 drinks per week (n, 26) was significantly higher (79.56) than that of those who drink more than 2 drinks per week (59.30; n, 10) ($P = .0016$). Those with elevated cholesterol (n, 32) also had a lower mean score (66.37) than that of those without elevated cholesterol (73.65; n, 132) ($P = .046$). In addition, obese individuals (n, 18) had a lower average score (59.36) than that of non-obese individuals (72.82; n, 146) ($P = .0016$) (Figure 4). Of note, obesity was a subjective measure; that is, it was listed among possible medical conditions.

Oxford Shoulder Questionnaire

Whereas the previous 2 questionnaires used scores out of a possible 100 (higher scores being associated with increased shoulder function), the Oxford Shoulder Questionnaire has

some noticeable differences. A lower score, for example, is associated with better shoulder function; possible scores range from 12 to 60 (best to worst). Shoulder injury and shoulder surgery were again associated with decreased shoulder function (increased score in this case) compared with those without injury or surgery (Table 4). Again, smokers (n, 30) reported significantly lower function (30.03) relative to those who do not smoke (24.40; n, 136) ($P = .0042$) (Figure 5). Moderately active individuals also had a lower mean score than that of participants with activity patterns on both ends of the activity spectrum ($P = .0006$). As in the other 2 questionnaires, those reporting elevated cholesterol (n, 32) had a significantly higher mean score (28.56) than that of those without elevated cholesterol (24.66; n, 131) ($P = .044$). Data from obese individuals (n, 18) showed statistical significance ($P = .0044$),

Figure 3. Scoring of shoulder dysfunction in smokers versus nonsmokers.

Figure 4. Shoulder ratings associated with different medical conditions.

with a higher mean score (31.61) than that of nonobese individuals (24.66; $n = 148$) (Figure 6).

Shoulder Pain

Three of the shoulder pain-related questions revealed statistically significant differences between smokers and nonsmokers, with cigarette smokers reporting higher complaints of pain (Table 5). In question 19, a higher score is associated with more shoulder pain, whereas in questions 31 and 34, lower scores are associated with more pain (Figure 2C).

Active Range of Motion

When compared with nonsmokers, cigarette smokers reported significantly lower active range of motion in both left and right shoulders (Tables 6 and 7). Survey responders who reported drinking alcoholic beverages in general had a greater active range of motion than did those who reported not drinking alcohol. There was also evidence of moderate exercise being associated with a greater range of motion, versus vigorous activity and lack of exercise; data were significant only for the left arm. Survey responders who reported a strenuous work pattern had less active range of motion than that of those who reported a moderate work pattern. This was significant for the left arm and it approached statistical significance in the right arm. Finally, those who reported shoulder surgery had a significantly lower active range of motion arc for the right arm; this decrease approached statistical significance for the left arm.

LIMITATIONS

The nature of this study is prone to selection bias. Only those who looked at the Web sites and elected to participate were included. There was also no control group. Therefore, it is hard to draw conclusions about the type of person who was looking at the Web sites, but it would probably be unusual for a person with good shoulder function and no pain to spend his or her free time looking at sites that deal with shoulder pathology.

DISCUSSION

Perhaps the most interesting finding in this study is the significantly lower reported shoulder function in participants who smoked cigarettes relative to those who claimed not to smoke. That this correlation was statistically significant in each questionnaire, as well as in the questions regarding perceived active range of motion, suggests a quantifiable link between smoking and shoulder dysfunction and pain. Although the correlation between smoking and decreased shoulder function is interesting, causation cannot be determined. Kane et al found a strong trend between smoking and rotator cuff disease at the microscopic level.⁵ Although a strong association was found between smoking and shoulder dysfunction, no link could be made to reported pack-years of smoking.

The statistically significant association between shoulder dysfunction and elevated cholesterol in all 3 questionnaires (but not range-of-motion queries) is an interesting association. Although no causation can be assumed from these results, research may eventually find that the deleterious vascular effects produced by smoking, hypercholesterolemia, and obesity may adversely affect the shoulder.

It seems intuitive that moderate exercise was associated with the best shoulder function, compared with higher intensity exercise programs and none at all. Such a judgment remains somewhat subjective in terms of what defines a *moderately* active lifestyle, compared with a *sedentary* or *strenuous*

Table 3. Association between Shoulder Rating Questionnaire and explanatory variables (univariate, n < 164).

Explanatory Variable	n	Mean $\pm$ SD ^a	P
Q4. Problematic side of shoulder			
Both	37	66.69 $\pm$ 16.41	.062
Left only	37	75.59 $\pm$ 17.10	
Right only	63	68.60 $\pm$ 17.77	
Q5. Smoking			
Yes	30	62.08 $\pm$ 19.20	.0008
No	134	74.50 $\pm$ 17.70	
Q6. Packs per day			
< 1	19	65.02 $\pm$ 21.73	.28
1-3	11	57.00 $\pm$ 13.17	
Q8. Work pattern			
Strenuous	7	60.90 $\pm$ 21.38	.0001
Active	26	60.51 $\pm$ 19.15	
Moderate	33	78.13 $\pm$ 15.21	
Normal	57	76.23 $\pm$ 15.86	
Sedentary	30	76.42 $\pm$ 17.04	
Multiple pairwise comparisons ^b			
Active–moderate		(−29.80, −5.45)	
Active–normal		(−26.70, −4.73)	
Active–sedentary		(−28.35, −3.47)	
Q10. Shoulder injury			
Yes	56	67.07 $\pm$ 18.10	.01
No	108	74.90 $\pm$ 18.30	
Q11. Shoulder surgery			
Yes	15	55.34 $\pm$ 17.80	.0002
No	149	74.00 $\pm$ 18.20	
Q12. Drinking			
Yes	90	75.61 $\pm$ 18.28	.012
No	73	68.08 $\pm$ 20.97	

(continued)

Table 3. (continued)

Explanatory Variable	n	Mean $\pm$ SD ^a	P
Q13A. Bottles of beer per week			
1-2	31	79.42 $\pm$ 12.60	.023
> 2	26	69.20 $\pm$ 18.81	
Q13B. Number of mixed drinks			
1-2	26	79.56 $\pm$ 15.94	.0016
> 2	10	59.30 $\pm$ 15.81	
Q13C. Glasses of wine per week			
1-2	26	76.31 $\pm$ 14.66	.084
> 2	16	67.40 $\pm$ 17.65	
Q18. Medical conditions			
High blood pressure			
Yes	39	67.94 $\pm$ 19.00	.099
No	125	73.56 $\pm$ 18.29	
Elevated cholesterol			
Yes	32	66.37 $\pm$ 18.38	.046
No	132	73.65 $\pm$ 28.39	
Obesity			
Yes	18	59.36 $\pm$ 17.98	.0016
No	146	72.82 $\pm$ 18.06	

^aEstimated standard deviation.^bSimultaneous 95% confidence intervals based on the Tukey-Kramer test procedure (significance level, .05).

one. The link between moderate alcohol consumption and greater shoulder function is another reason for further study of the associations drawn from this survey. Note, however, that moderate daily alcohol intake has been shown to have a beneficial cardiovascular affect.^{8,12}

The preceding findings raise many questions, and follow-up studies with greater participation will be necessary for validation. The data used in this study comprised 166 entries; a larger number will no doubt be necessary to confirm findings. Furthermore, of those entries, 134 came from Caucasian participants; a more heterogeneous population may shed some light on ties between shoulder dysfunction and race-related factors. As with any survey, it is difficult to draw a truly random population, but this is an important factor.

Inadequate population sampling and unintentional selection bias can skew the results. Last, specific causes of decreased shoulder function were never addressed. Further evaluation of dysfunctions may validate the correlations drawn from this survey.

CONCLUSION

A statistically significant correlation between decreased shoulder function and cigarette smoking was found (relative to those who do not smoke), along with a similar correlation between decreased shoulder function and elevated cholesterol and obesity. Further in-depth study of these factors appears warranted.

Table 4. Association between Oxford score and explanatory variables (univariate, $n < 166$).

Explanatory Variable	n	Mean $\pm$ SD ^a	P
Q4. Problematic shoulder			
Both	37	28.51 $\pm$ 9.00	.068
Left only	37	23.73 $\pm$ 6.96	
Right only	63	27.05 $\pm$ 10.13	
Q5. Smoking			
Yes	30	30.03 $\pm$ 9.55	.0042
No	136	24.40 $\pm$ 9.95	
Q6. Packs per day			
< 1	19	28.32 $\pm$ 10.1	
1-3	11	33.00 $\pm$ 7.38	.22
Q8. Work pattern			
Strenuous	7	30.86 $\pm$ 6.74	.0006
Active	26	30.00 $\pm$ 10.48	
Moderate	33	20.42 $\pm$ 5.85	
Normal	57	24.16 $\pm$ 8.94	
Sedentary	30	24.60 $\pm$ 9.95	
Multiple pairwise comparisons ^b			
Strenuous–moderate		(0.320, 20.546)	
Active–normal		(0.091, 11.594)	
Active–moderate		(3.203, 15.949)	
Q10. Shoulder injury			
Yes	56	28.25 $\pm$ 8.89	.0077
No	110	23.98 $\pm$ 10.00	
Q11. Shoulder surgery			
Yes	15	37.87 $\pm$ 6.36	<.0001
No	151	24.18 $\pm$ 9.26	
Q12. Drinking			
Yes	90	23.66 $\pm$ 8.52	.014
No	76	27.50 $\pm$ 10.90	

(continued)

Table 4. (continued)

Explanatory Variable	n	Mean $\pm$ SD ^a	P
Q13A. Bottles of beer per week			
1-2	31	21.77 $\pm$ 6.83	.04
> 2	26	26.35 $\pm$ 9.35	
Q13B. Number of mixed drinks			
1-2	26	22.73 $\pm$ 9.30	.005
> 2	10	33.20 $\pm$ 9.78	
Q13C. Glasses of wine per week			
1-2	26	22.73 $\pm$ 7.45	.0077
> 2	16	30.56 $\pm$ 10.63	
Q18. Medical conditions			
High blood pressure			
Yes	39	27.05 $\pm$ 9.67	.24
No	127	24.91 $\pm$ 9.88	
Elevated cholesterol			
Yes	32	28.56 $\pm$ 10.85	.044
No	131	24.66 $\pm$ 9.43	
Obesity			
Yes	18	31.61 $\pm$ 9.64	.0044
No	148	24.66 $\pm$ 9.63	

^aEstimated standard deviation.^bSimultaneous 95% confidence intervals based on the Tukey-Kramer test procedure (significance level, .05).

Figure 5. Oxford rating of shoulder dysfunction in smokers versus nonsmokers.

Figure 6. Oxford shoulder scores associated with different medical conditions.

Table 5. Association between shoulder pain and smoking (yes/no, packs per day).

Pain From Shoulder / Smoking	n	Mean Rank	<i>P</i> ^a
Q19. Worst pain			
Yes, smoking	30	99.47	.037
No	136	79.98	
< 1 pack per day	19	15.18	.89
1-3	11	15.68	
Q31. Usual pain (recent)			
Yes, smoking	30	67.62	.04
No	135	86.42	
< 1 pack per day	19	16.48	.43
1-3	11	13.86	
Q34. Severe pain (recent)			
Yes, smoking	30	67.07	.04
No	135	86.54	
< 1 pack per day	19	15.95	.72
1-3	11	14.73	

^a*P* values are based on the Wilcoxon 2-sample rank sum test (2-sided).

Table 6. Association between maximum possible motions—left and explanatory variables (univariate, n < 136).

Explanatory Variable	n	Mean ± SD ^a	<i>P</i>
Q4. Problematic shoulder			
Both	31	10.48 ± 3.53	
Left only	28	11.11 ± 2.86	.017
Right only	54	12.31 ± 2.56	
Multiple pairwise comparisons ^b			
Right only—both		(0.2642, 3.3977)	
Q5. Smoking			
Yes	23	9.65 ± 4.41	.024
No	113	11.94 ± 2.80	
Q6. Packs per day			
< 1	14	10.57 ± 4.55	.22
1-3	9	8.22 ± 4.00	

(continued)

Table 6. (continued)

Explanatory Variable	n	Mean $\pm$ SD ^a	P
Q8. Work pattern			
Strenuous	7	8.71 $\pm$ 4.03	
Active	21	10.24 $\pm$ 3.91	
Moderate	24	12.96 $\pm$ 1.68	.0004
Normal	50	12.32 $\pm$ 2.03	
Sedentary	30	11.96 $\pm$ 3.17	
Multiple pairwise comparisons ^b			
Strenuous–moderate		(−7.50, −0.99)	
Strenuous–normal		(−6.66, −0.55)	
Strenuous–moderate		(−6.48, −0.02)	
Active–moderate		(−4.99, −0.46)	
Active–normal		(−4.05, −0.11)	
Q10. Shoulder injury			
Yes	50	11.32 $\pm$ 3.02	.53
No	86	11.69 $\pm$ 3.34	
Q11. Shoulder surgery			
Yes	12	9.33 $\pm$ 4.46	.089
No	124	11.77 $\pm$ 3.01	
Q12. Drinking			
Yes	79	12.28 $\pm$ 2.22	.0043
No	57	10.54 $\pm$ 4.04	
Q13A. Bottles of beer per week			
1-2	26	12.77 $\pm$ 1.40	.10
> 2	21	11.48 $\pm$ 3.25	
Q13B. Number of mixed drinks			
1-2	19	12.47 $\pm$ 2.32	.078
> 2	7	8.71 $\pm$ 4.64	
Q13C. Glasses of wine per week			
1-2	22	12.18 $\pm$ 2.61	.13
> 2	13	10.54 $\pm$ 3.60	

(continued)

Table 6. (continued)

Explanatory Variable	n	Mean $\pm$ SD ^a	P
Q18. Medical conditions			
High blood pressure			.026
Yes	30	10.40 $\pm$ 3.61	
No	106	11.88 $\pm$ 3.04	
Elevated cholesterol			
Yes	28	10.07 $\pm$ 3.88	.023
No	108	11.94 $\pm$ 2.93	
Obesity			
Yes	15	10.53 $\pm$ 3.56	.20
No	121	11.68 $\pm$ 3.17	

^aEstimated standard deviation.^bSimultaneous 95% confidence intervals based on the Tukey-Kramer test procedure (significance level, .05).

Table 7. Association between maximum possible motions—right and explanatory variables (univariate, n < 136).

Explanatory Variable	n	Mean $\pm$ SD ^a	P
Q4. Problematic shoulder			
Both	31	10.42 $\pm$ 3.50	
Left only	25	13.28 $\pm$ 1.43	.0003
Right only	53	11.21 $\pm$ 2.38	
Multiple pairwise comparisons ^b			
Left only—right only		(0.5763, 3.5686)	
Left only—both		(1.2031, 4.5182)	
Q5. Smoking			
Yes	19	10.47 $\pm$ 4.10	.024
No	114	11.63 $\pm$ 2.88	
Q6. Packs per day			
< 1	14	10.93 $\pm$ 4.18	.42
1-3	5	9.20 $\pm$ 3.56	

(continued)

Table 7. (continued)

Explanatory Variable	n	Mean $\pm$ SD ^a	P
Q8. Work pattern			
Strenuous	4	11.25 $\pm$ 4.03	
Active	20	10.25 $\pm$ 3.91	
Moderate	28	12.29 $\pm$ 1.68	.06
Normal	48	12.20 $\pm$ 2.03	
Sedentary	24	11.50 $\pm$ 3.17	
Q10. Shoulder injury			
Yes	48	11.56 $\pm$ 2.64	.79
No	85	11.41 $\pm$ 3.31	
Q11. Shoulder surgery			
Yes	12	8.92 $\pm$ 3.92	.0023
No	121	11.72 $\pm$ 2.88	
Q12. Drinking			
Yes	74	12.20 $\pm$ 2.20	.0032
No	59	10.54 $\pm$ 3.72	
Q13A. Bottles of beer per week			
1-2	26	12.04 $\pm$ 1.78	.93
> 2	20	12.10 $\pm$ 2.77	
Q13B. Number of mixed drinks			
1-2	22	13.09 $\pm$ 1.44	.24
> 2	4	10.00 $\pm$ 4.24	
Q13C. Glasses of wine per week			
1-2	19	12.00 $\pm$ 2.36	.75
> 2	13	11.70 $\pm$ 3.15	
Q18. Medical conditions			
High blood pressure			
Yes	28	11.21 $\pm$ 3.25	.63
No	105	11.53 $\pm$ 3.04	
Elevated cholesterol			
Yes	26	11.12 $\pm$ 3.13	.52
No	107	11.55 $\pm$ 3.07	

(continued)

Table 7. (continued)

Explanatory Variable	n	Mean $\pm$ SD ^a	P
Obesity			
Yes	15	10.87 $\pm$ 3.18	.43
No	118	11.54 $\pm$ 3.07	

^aEstimated standard deviation.^bSimultaneous 95% confidence intervals based on the Tukey-Kramer test procedure (significance level, .05).

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