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Is there a correlation between hypermobility of the spine and chronic neck/back pain in young adults?

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Abstract

This cross-sectional study aimed to explore the correlation between hypermobility of the spine and chronic neck/back pain in a university-aged population. Chronic musculoskeletal pain, especially joint pain, is said to be the main complaint of individuals with symptomatic joint hypermobility. Generalized joint hypermobility is usually limited to a small number of joints, with increased range of motion of the lumbar spine the most common form of joint hypermobility. The study collected data over a six-year period from undergraduate Anatomy & Physiology students at a university in the United States, using an anonymous survey. Based on the data from 1,211 respondents the study found that: 1) young adult females are more likely to have hypermobility of the spine than young adult males; 2) young females with spine hypermobility are not more likely to report chronic neck/back pain than females without spine hypermobility; 3) young adult males with spine hypermobility are more likely to report chronic neck/back pain than males without spine hypermobility; 4) young females and males with spine hypermobility experience the same average levels of pain intensity for their chronic neck/back pain than their peers without spine hypermobility; 5) young females with and without spine hypermobility report higher levels of chronic pain intensity than males for chronic neck/back pain.

Introduction

Joint hypermobility is the ability of a joint to move beyond the normal range of motion[1]. This condition is due to inherited alterations of proteins that lead to a laxity of connective tissue. Changes to the connective tissue matrix caused by mutations in genes that code for proteins, such as collagens, fibrillins, elastins, and proteoglycans, affect the stability of joint capsules and the extensibility of ligaments and tendons[1-3]. There is, however, no consensus on the underlying pathophysiology of joint hypermobility and why it usually affects only some joints[4,5].

The scoring system most commonly used for the diagnosis of joint hypermobility was created by Beighton, Solomon and Soskolne in 1973[6]. Scoring involves assessing the range of movement for nine joints, with each joint scored as either hypermobile (score = 1) or of normal mobility (score = 0). Thus, the total score (or Beighton score) can range from 0 to 9, with higher scores indicating greater overall joint hypermobility (Table 1). Based on recommendations of the International Consortium on the Ehlers-Danlos syndromes (EDS), the diagnosis of generalized joint hypermobility (GJH) requires a Beighton score of ≥ 5 for pubertal men and women up to the age of 50[7].

Table 1: The Beighton criteria for joint hypermobility

1. Passive dorsiflexion of the little fingers beyond 90° (one point for each hand) – two points
2. Passive apposition of the thumbs to the flexor aspects of the forearm (one point for each thumb) – two points
3. Hyperextension of the elbows beyond 10° (one point for each elbow) – two points
4. Hyperextension of the knee beyond 10° (one point for each knee) – two points
5. Forward flexion of the trunk with knees fully extended so that the palms of the hands rest flat on the floor – one point

Although the term 'generalized joint hypermobility' implies that multiple or all diarthrotic joints of the body are affected, most of the time the condition is pauciarticular, i.e., limited to a small number of joints, and not all joints used as part of the Beighton score are equally affected[8,9]. Most studies found that hypermobility of the spine, i.e., increased range of motion (ROM) of the lumbar spine, is more common than hypermobility of any of the other joints used in the Beighton score. For instance, almost five in ten participants had a positive trunk flexion test, i.e., were able to rest the palms of their hands flat on the floor with both knees fully extended, in the study by Reuter & Fichthorn[10]. The percentage of female study participants with spine hypermobility was significantly higher than the percentage of male participants (52.5% vs. 25.1%). Likewise, among the participants in the study by Riveros et al., spine hypermobility was more common than other hypermobilities, with 40% of female participants and 18% of male participants having increased lumbar ROM[11].

The main complaint of individuals with symptomatic GJH is chronic musculoskeletal pain (MSP), especially joint pain (arthralgia). Because of this connection between GJH and MSP, the Brighton criteria for the diagnosis of benign joint hypermobility syndrome (BJHS) include arthralgia lasting for longer than 3 months in four or more joints as a major criterion and arthralgia of less than 3 months in one to three joints or back pain of less than 3 months as a minor criterion (Table 2)[12].

According to published studies, chronic MSP may affect daily activities of people with joint hypermobility, leading to a decreased quality of life[13-15]. Patients may complain of pain in several joints, fatigue, and muscle weakness[16,17,4]. A systematic review of GJH and MSP in children, nonetheless, did not uncover an association of GJH and MSP in Caucasian populations and only a potential association in African and Asian populations[18]. Additionally, while some longitudinal studies indicate an association between GJH and chronic MSP, they do not provide evidence for GJH being a causative factor for MSP[19,20]. Likewise, the study by Reuter & Fichthorn did not find an association between GJH and MSP in a university-aged population[10]. On the other hand, reduced lumbar spine mobility has also been implicated as a factor contributing to low back pain (LBP)[21,22]. However,

Table 2: The Brighton criteria for the diagnosis of benign joint hypermobility syndrome (BJHS)*

Major criteria
1. A Beighton score of 4/9 or greater (either currently or historically)
2. Arthralgia for longer than 3 months in 4 or more joints
Minor criteria
1. A Beighton score of 1, 2 or 3/9 (0, 1, 2 or 3 if aged 50+)
2. Arthralgia (>3 months) in one to three joints or back pain (>3 months), spondylosis, spondylolysis/spondylolisthesis
3. Dislocation/subluxation in more than one joint, or in one joint on more than one occasion
4. Soft tissue rheumatism >3 lesions (e.g., epicondylitis, tenosynovitis, bursitis)
5. Marfanoid habitus (tall, slim, span/height ratio >1.03, upper:lower segment ratio <0.89, arachnodactyly [positive Steinberg/wrist signs])
6. Abnormal skin: striae, hyperextensibility, thin skin, papyraceous scarring
7. Eye signs: drooping eyelids or myopia or antimongoloid slant
8. Varicose veins or hernia or uterine/rectal prolapse

*BJHS is diagnosed in the presence of two major criteria, or one major and two minor criteria, or four minor criteria. Two minor criteria will suffice where there is an unequivocally affected first-degree relative. Major criterion 1 and minor criterion 1 are mutually exclusive as are major criterion 2 and minor criterion 2.

it is unclear whether the reduced lumbar ROM is a main cause of LBP in young adults. Studies involving adolescents and young adults found that a variety of factors, such as smoking, marital status, stress, and sedentary behavior, were associated with an increased prevalence of LBP[23,24].

Low back pain is one of the most common medical complaints in children, adolescents, and adults. Based on data from the Global Burden of Disease, Injuries, and Risk Factors Study 2017 (GBD), Wu et al. concluded that the number of people suffering from LBP globally was 577 million in 2017[25]. This would make LBP the leading cause of years lived with disability (YLDs) worldwide. The data also indicate that the prevalence of LBP is higher in females than males and increases with age.

In the United States (US), data from the National Health Interview Survey show that in 2019 almost three in ten young adults (age 18–29) suffered from back pain[26]. However, the study did not distinguish low back pain from neck pain and acute from chronic pain. Women were more likely to report back pain than men (40.6% vs. 37.2%). A study by Stevans et al. found that one-third of patients with acute LBP transitioned to chronic LBP within six months of developing acute symptoms[27]. Overall, one in seven adults suffers from chronic LBP, making it the leading cause of disability in the US[28,29].

There are many factors beyond biophysical factors contributing to chronic LBP, among them genetic, social, and psychological factors in addition to comorbidities. Even in patients with Hypermobility Spectrum Disorder

(HSD) or Ehlers-Danlos syndrome, the structural changes cannot reliably explain the pain symptomatic[30]. Kim at al. showed that lumbar disc degeneration was associated with an increase in joint hypermobility and chronic LBP[31].

As of writing, no study looking into a correlation between spine hypermobility and chronic neck/back pain in young adults has been identified. Therefore, the purpose of our cross-sectional study was to investigate the following questions: A) Are young adults with spine hypermobility more likely to suffer from chronic neck/back pain than their peers with normal lumbar ROM? B) Is there a difference in the prevalence of chronic neck/back pain between young females and males with and without increased lumbar ROM? C) Is there a difference in the self-reported pain level between young adults with and without spine hypermobility?

Methods

Ethical research statement

The research protocol was approved by the Institutional Review Board (IRB) of our university before data collection commenced. The survey included a consent form approved by the IRB; i.e., written consent was obtained. Participation was voluntary and participants did not receive any compensation or any other direct or indirect benefit from the university or us. All faculty and students involved in data collection completed training in ethical data collection.

Data collection

Over a period of six years (2016-2022), students enrolled in an undergraduate Human Anatomy & Physiology with lab I course were invited to participate in an anonymous survey during the lab module on joints. The students learned about joint structure and function, including range of movement and hypermobility. As part of the module, students assessed each other's joints as a group assessment using goniometers under the supervision of trained members of the research team. Based on the Beighton criteria for joint hypermobility (Table 1), students were instructed to rate their spine as hypermobile if they were able to rest the palms of their hands flat on the floor with their knees fully extended. Participants were also asked to rate any chronic neck or back pain (pain lasting three months or more) using a scale ranging from 0 (no pain) to 10 (worst pain).

The survey was described previously[10]. Some of the data collected, but unrelated to the current research, has been published elsewhere[10,32].

Data analyses

Data are presented as a percentage of the total participant pool, or a proportion of this pool, for questions with categorical answers. For questions with quantitative answers, data are presented as means with standard deviations. Due to the voluntary nature of the survey, sample sizes vary for different analyses but are indicated. All statistical analyses were performed using the JMP software program (JMP®, Version 16; SAS Institute Inc., Cary, NC, USA).

Participants were subdivided into two groups, one containing participants with spine hypermobility and one with participants without spine hypermobility. Pearson Chi-Square Tests were used to determine: 1) whether female and male participants differed in the rates of spine hypermobility; 2) whether female participants with spine hypermobility were more likely to report chronic neck/back pain than females without spine hypermobility; 3) whether male participants with spine hypermobility were more likely to report chronic neck/back pain than males without spine hypermobility; 4) whether female participants with spine hypermobility reported different average levels of pain intensity for their chronic neck/back pain than females without spine hypermobility; 5) whether male participants with spine hypermobility reported different average levels of pain intensity for their chronic neck/back pain than males without spine hypermobility; and 6) whether female participants with and without spine hypermobility reported higher levels of chronic pain intensity than male participants for chronic neck/back pain.

Results

Study population

Of the 1,297 students who participated in the survey, 86 respondents were excluded from the analyzed data set because they did not indicate a biological sex or age, were younger than 18 years of age, did not provide information on the mobility of their spine, or did not provide information on chronic neck/back pain. Therefore, the analyzed pool of study participants was reduced to 1,211 participants, consisting of 906 female (74.8%) and 305 male participants (25.2%).

Study population profile (n = 1,211)
Biological sex: 74.8% female students, 25.2% male students
Race/ethnicity: 63.6% Caucasian/White, 13.9% Hispanic, 8.2% African American/Black, 2.1% Asian, 12.2% more than one ethnicity/race or ethnicity/race other than listed
Age: 19.3 ± 1.7 years (mean ± standard deviation; range: 18 - 30 years; median age = 19 years)

Spine hypermobility

One in seven participants (13.8%) had a Beighton score of ≥ 5, five in ten participants had a Beighton score from 1-4, and three in ten participants reported no joint laxity (Beighton score 0). Among female participants, 15.7% had

Table 3: Proportion of participants reporting spine hypermobility for all, female, and male participants.

Spine hypermobility	All participants (n = 1211)	Female participants (n = 906)	Male participants (n = 305)
Yes	45.6%	51.8%	27.2%
No	54.4%	48.2%	73.8%

Table 4: Proportion of participants with and without spine hypermobility reporting chronic neck/back pain for all, female, and male participants.

Chronic neck/back pain	All participants	Female participants	Male participants
Spine hypermobility			
Yes	25.0%	24.3%	28.9%
No	75.0%	75.7%	71.1%
No spine hypermobility			
Yes	19.9%	23.6%	12.6%
No	80.1%	76.4%	87.4%

Table 5: Self-reported pain intensity for chronic neck/back pain for all, female, and male participants. The table depicts means ± std. dev with the range of pain values reported by participants and the median.

	All participants	Female participants	Male participants
Spine hypermobility	4.8 ± 2.0; 1.5-10; 4	4.9 ± 2.0; 1.5-10; 4	4.0 ± 1.7; 2-8; 3.5
No spine hypermobility	4.5 ± 1.5; 1-8; 4	4.6 ± 1.4; 2-8; 4.5	4.0 ± 2.0; 1-8; 4

a Beighton score of ≥ 5, 60.7% a score of 1-4, and 23.8% had no joint laxity. For male participants, the corresponding numbers were 8.2% (Beighton score ≥ 5), 46.9% (Beighton score 1-4), and 44.9% (Beighton score 0), respectively.

Overall, 45.6% of participants reported hypermobility of the spine (Table 3). Female participants were more likely to have spine hypermobility (51.8%) than male participants (27.2%; Pearson Chi-square Test, Chi-square = 42.530, DF = 1, $p < 0.0001$).

Self-reported chronic neck/back pain

Sixty percent of participants with self-reported chronic pain (i.e., pain lasting 3 months or more) suffered from low back pain (59.8%), 10.8% from unspecified back pain, 6.8% from neck pain, 4.0% from upper back pain, and 18.6% from pain in the neck and back or more than one region of the back.

Participants with spine hypermobility were more likely to report chronic neck/back pain (25.0% of n = 552 respondents with spine hypermobility; Table 4) than participants without spine hypermobility (19.9% of n = 659 respondents without spine hypermobility; $p = 0.0329$).

Female participants with spine hypermobility were not more likely to report chronic neck/back pain (24.3% of n = 469 respondents with spine hypermobility) than female participants without spine hypermobility (23.6% of n = 437 respondents without spine hypermobility; $p = 0.7554$).

Male participants with spine hypermobility were more likely to report chronic neck/back pain (28.9% of n = 83 respondents with spine hypermobility) than male participants without spine hypermobility (12.6% of n = 222 respondents without spine hypermobility; $p = 0.0020$).

Female and male participants with spine hypermobility had the same likelihood to experience chronic neck/back pain (24.3% of n = 469 female participants vs. 28.9% of n = 83 male participants; $p = 0.6238$). Female participants without spine hypermobility were significantly more likely to suffer from chronic neck/back pain than male participants without spine hypermobility (23.6% of n = 437 vs. 12.6% of n = 222; $p = 0.0034$).

Pain intensity

Participants who reported chronic neck/back pain were asked to enter information about the intensity of chronic neck/back pain on a scale from 0 to 10 (Table 5). Participants with spine hypermobility did not report different average levels of pain intensity for their chronic neck/back pain (4.8 +/- 2.0, mean +/- std. deviation; n = 121 respondents with spine hypermobility) than participants without spine hypermobility (4.5 +/- 1.5, mean +/- std. deviation; n = 122 respondents without spine hypermobility; $p = 0.2735$). This holds true for both female ($p = 0.2682$) and male participants ($p = 0.9884$).

Female participants with chronic neck/back pain reported higher levels of pain intensity than male participants for both chronic neck/back pain with spine hypermobility ($p = 0.0173$) and without spine hypermobility ($p = 0.0346$).

Discussion

The present study increases knowledge about the correlation between spine hypermobility and chronic neck/back pain in young adults on the strength of data collected from 1,211 undergraduate students at an American university. Based on the results of our study,

we can report that young female adults are more likely to have an increased range of motion of the lumbar spine than young male adults. However, only young adult males with spine hypermobility are suffering from chronic neck/back pain more than their peers without spine hypermobility. Among young female adults, the percentage having chronic neck/back pain is the same for females with and without spine hypermobility. Yet, young female adults without spine hypermobility are significantly more likely to experience chronic neck/back pain as their male counterparts. Both young males and females with chronic neck/back pain reported similar levels of pain intensity regardless of having or not having an increased range of motion of the lumbar spine. Nonetheless, female adults with and without spine hypermobility with chronic neck/back pain reported experiencing higher levels of pain intensity than male adults.

Spine hypermobility

Reuter & Fichthorn and Riveros et al. also found that hypermobility of the spine is more common than hypermobility of any of the other joints used in the Beighton score, and that female adults are more likely to have spine hypermobility than male adults[10,11]. This finding is also in line with Quatman et al. reporting that young adult females have greater joint laxity scores compared to males due to structural changes occurring during puberty[33].

Self-reported chronic neck/back pain

The percentage of study participants reporting to suffer from chronic neck/back pain with 25.0% for participants with spine hypermobility and 19.9% for participants without spine hypermobility, which is similar to the percentages described in previous studies. Hestbaek et al. reported an annual LBP prevalence of 32.4% in young adults and Lucas et al. a prevalence of 28.4% for the age group 18-29[23,26]. Whereas in our study male participants with spine hypermobility reported suffering more from chronic neck/back pain than their peers without spine hypermobility, women were more likely to suffer from back pain than men in the studies by Wu et al. and Lucas et al.[25,26].

Pain intensity

The average self-reported levels of pain intensity for chronic neck/back pain did not differ between participants with and without spine hypermobility. Therefore, it may be inferred that spine hypermobility does not influence chronic neck/back pain intensity levels in young adults. However, females with chronic neck/back pain reported higher levels of pain intensity than males for both chronic neck/back pain with and without spine hypermobility. This finding is supported by Templeton and Racine et al., who both found that women are more likely to experience a variety of chronic pain syndromes and tend to report more severe pain than men[34,35]. The differences in pain perception between men and women may be attributed to differences in sex-hormone production, anatomy, neuromuscular control, and inflammatory responses[33,34,36].

Study limitations

The two main limitations of this study are: 1) participant selection and 2) reliance on self-reported chronic pain and pain levels. Students enrolled in our undergraduate Human Anatomy & Physiology with lab I classes are mainly pre-nursing majors, which explains why almost three-quarters of participants in our study were young females. Still, using a convenience sample of students may have introduced a selection bias because the composition of the study population does not match the composition of the overall population. Second, participants were asked to report whether they suffer from chronic neck/back pain and rate the pain severity on a scale from 0-10. Even though our survey contained a definition of chronic pain as pain lasting three months or more, participants may have reported suffering from chronic pain without actually having suffered for such an extended period of time, creating a case of information bias. However, there is no indication that participants with or without hypermobility of the spine may have been more prone to misjudge the length of time they have been suffering from pain.

Conclusions

This study found that young adult females are more likely to have hypermobility of the spine than young adult males. Young females with spine hypermobility are as likely to experience chronic neck/back pain as male adults with spine hypermobility and are not more likely to report chronic neck/back pain than female adults without spine hypermobility. However, adult females without spine hypermobility are significantly more likely to suffer from chronic neck/back pain than male adults without spine hypermobility. Female adults experience higher levels of pain intensity than male adults for both chronic neck/back pain with and without spine hypermobility. Young adult males with spine hypermobility are more likely to suffer from chronic neck/back pain than their peers without spine hypermobility. Nonetheless, they do not experience higher levels of pain and their average self-reported pain levels are lower than those of young adult females.

Conflict of Interest

The authors declare that there is no conflict of interest. The authors did not receive funding for this study and have full control of all primary data.

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