Journal of General Practice
ISSN: 2329-9126

Deall and Majeed, J Gen Pract (Los Angel) 2016, 4:5
DOI: 10.4172/2329-9126.1000275

Review Article Open Access

Effect of Cold Weather on the Symptoms of Arthritic Disease: A Review of the Literature

Ciara Deall and Haroon Majeed*

The Royal Stoke University Hospital, Trauma and Orthopaedics, Newcastle Road, Stoke-on-Trent, England, UK

***Corresponding author:** Haroon Majeed, The Royal Stoke University Hospital, Trauma and Orthopaedics, Newcastle Road, Stoke-on-Trent, England, UK, Tel: +44-7973-824289; E-mail: haroonmajeed@gmail.com

Received date: October 27, 2016; **Accepted date:** November 14, 2016; Published **date:** November 21, 2016

Abstract

It is a common observation that pain and stiffness in patients known to have arthritis get worse in cold and damp weather conditions. The objective of this article is to review the available literature on this subject and to put forward an explanation for this common clinical finding. Literature search revealed twelve relevant articles including laboratory experiments and prospective questionnaire-based human studies. Various investigators have tried to study the effect of cold weather on arthritic symptoms and have suggested different theories. The effect of temperature changes localized to the joints has shown to increase stiffness at lower temperatures and decrease stiffness at higher temperatures. The effect of these changes has been found more pronounced in elderly population with arthritis and patients with advanced disease. The evidence to support this common observation is weak; however some studies have reported a trend towards worsening of pain and stiffness with falling temperature and barometric pressure in arthritic patients.

Keywords: Joint stiffness; Arthritic symptoms; Rheumatoid arthritis; Osteoarthritis; Cold weather; Joints

Introduction

Patients with chronic joint pain frequently report worsening of their pain and stiffness due to changes in the weather. Patients who are known to have arthritis and live in colder climate have been shown to report more pronounced symptoms of their illness than those living in warmer areas, even though the pathologic joint involvement has not been found different. It has been suggested that approximately 80% to 90% patients with arthritic disease could be sensitive to cold weather and falling barometric pressures in the presence of humidity [1]. Studies of patients with chronic pain have documented some association between the level of joint symptoms and the cold weather [2-4]. However, there is some evidence suggesting that pain in some individuals is affected more by weather conditions than in others, and that each individual reacts in different ways to the changes in weather [5].

Stiffness in joints is an important clinical feature as well as a major diagnostic criterion in the diagnosis of rheumatoid arthritis (RA) and osteoarthritis (OA). Patients find that stiffness imposes a great limitation in mobility of their joints and is also associated with increasing pain. Winter is energetically more demanding and stressful, during which the thermoregulatory demands typically increase [6]. Different theories have been proposed and experiments have been performed to find an explanation for the worsening of joint symptoms in cold weather; however the mechanism behind this effect remains largely unknown [7]. We hypothesized that symptoms of arthritic disease deteriorate in cold and damp climate and reviewed the available literature on this subject to suggest an explanation for this common belief and observation.

Methodology

Literature was searched from PubMed, Embase, the Cochrane electronic databases, Elsevier Scopus and Google Scholar. The primary terms searched included 'joint stiffness in winter months' and 'cold weather', 'pathophysiology of synovial joint stiffness', 'effect of weather on arthritic joints 'and' arthritic symptoms in cold climate'.

All types of studies, which involved laboratory experimental studies, biomechanical models, cadaveric specimens, questionnaire-based studies, case-series reviews on human subjects and review articles were searched. Studies on patients with osteoarthritis (OA), rheumatoid arthritis (RA) and healthy population were included. No article was excluded based on the chronicity of the available studies or the sample size. The abstracts of the searched articles were reviewed first, to assess their relevance and then the full text articles were obtained through online access or manual search through the library access.

Studies published only in English language were selected, and those in other languages whose English translation was not available, were excluded. Twelve articles whose full texts were available and which fulfilled the above criteria were included in the final selection. Table 1 shows the main features of the included studies.

Results

To determine the effect of cold climate on joints, Wright and Johns [8] performed an experiment on two subjects, in which the hand was immersed in ice water. The temperature of the forearm muscles remained constant (recorded from an intramuscular thermistor needle). There was a 10% to 20% increase in stiffness on cooling. It was interesting to note that in arthritic joints the relation between elastic, viscous, and frictional stiffness was the same as in normal joints. Only in severely damaged joints, which showed marked clinical and radiographic deterioration, could excessive friction be demonstrated.

Even in these joints frictional stiffness did not contribute significantly to joint stiffness, the major component increased was elastic stiffness.

Hollander [9] performed an interesting study on patients with obvious symptoms and signs of OA (n=4) and RA (n=8). Hollander created a climate-controlled room in his laboratory where all five climatic factors including temperature, humidity, barometric pressure, and air flow and air ionization were controlled. Hollander observed these patients in this chamber in pairs for a period of two weeks each. Hollander found that six of the eight RA patients and all four OA patients reported more pain and stiffness when humidity was increased and barometric pressure was decreased. No changes in pain perception were reported when only one weather parameter was changed. However, this study used a small number of subjects and only a short duration of time was spent in the chamber.

Authors	Type of Study	Year	Country	Disease	No of Patients
Wright & John [8]	Lab experiment	1960	Baltimore, USA	Healthy subjects	2
Hollander [9]	Climate-controlled chamber	1961	New York, USA	RA & OA	12
Patberg et al. [10]	Prospective pain diary	1985	Netherlands	RA	88
Silbley [11]	Prospective double-blind questionnaire	1985	Canada	RA & OA	70
Guedj and Weinberger [12]	Questionnaire-based interview	1990	Israel	RA & OA	62
Shutty et al. [4]	Questionnaire-based interview	1992	Virginia, USA	RA & OA	70
Hoppe et al. [13]	Questionnaire-based	1994	Germany	Healthy subjects	1064
Jamison et al. [7]	Multicentre questionnaire-based interview	1995	Boston, USA	RA & OA	558
Hawley et al. [14]	Questionnaire-based interview	2001	Kansas, USA	RA, OA, Fibromyalgia	1424
Inaba and Mirbod [15]	Questionnaire-based interview	2010	Japan	Healthy subjects	74
Smedslund and Hagen [5]	Systematic review	2011	Norway		

Table 1: Summary of the included studies.

Patberg et al. [10] performed a prospective study on 88 patients with RA. They selected these patients randomly from outpatients department with age ranging between 30 years to 68 years and an established disease of 5 years to 30 years duration with 90% being seropositive. The patients were given diaries to record their pain levels at different timings of the day for the duration of one whole year. The results of this study showed that increasing humidity and falling barometric pressure produced increased arthritic pain, swelling and stiffness in patients with an established rheumatoid arthritis.

In a prospective, double-blind study on 70 patients (RA: 35, OA: 35), Sibley [11] compared the severity of rheumatic symptoms to changes in weather conditions using a Visual Analogue Scale (VAS). The majority of patients (62%) believed that various aspects of weather aggravated their symptoms. There was no difference in age, gender, diagnosis or perceived symptom severity between weather-sensitive and weather-insensitive patients. No significant correlation was found between symptoms of any patient group or individual with any of 13 combinations of weather features. These results suggested that contrary to the belief of the majority of patients with RA or OA; external weather conditions did not significantly influence the day-to-day symptoms of arthritis.

Guedj and Weinberger [12] performed a prospective questionnaires-based study on 62 patients with arthritic disease including rheumatoid arthritis and osteoarthritis. Morning weather conditions were changeable: temperature ranged from 8°C to 27°C, barometric pressure from 1007 mbar to 1025 mbar, and relative humidity from 39% to 96%. Swelling and everyday activity were compared with changes in daily weather conditions. In most patients, change in weather increased arthritic symptoms. Women were found more sensitive to weather changes than men (62% v 37%). Pain was affected positively by barometric pressure and temperature in RA and by temperature, rain and barometric pressure in OA. Based on the statistical analysis of their study, Guedj and Weinberger supported the belief of most rheumatic patients that weather conditions significantly influence their day-to-day symptoms [12].

Shutty et al. [4] interviewed 70 patients with chronic joint pain. They created Weather and Pain Questionnaire (WPQ) that assessed the patients' sensitivity to the meteorological variables of temperature, sudden weather changes, humidity, precipitation and sunshine. The symptoms assessed were pain intensity, duration and interference with functional activities. Their tool was designed using factor analysis to produce a Weather Sensitivity Index (WSI) with high internal consistency and test-retest reliability. Reporting patterns suggested that patients could reliably identify which meteorological variables influenced their pain but could not reliably determine which of their symptoms were consistently affected. They reported that temperature (87%) and humidity (77%) had the greatest effect on their pain and stiffness. Patients who were labeled 'weather-sensitive' reported significantly greater pain intensity, longer duration of pain, and more sleep disturbances.

Jamison et al. [7] investigated differences in the perceived influence of weather on pain in a prospective multicenter questionnaire-based study on 558 patients living in 4 cities of United States. Local climatologic data of each city were obtained from the National

Climatic Data Centre. All patients completed a weather questionnaire and the information they provided was compared with demographic and weather variables. Majority of patients with chronic pain perceived changes in weather as affecting their pain and stiffness. Most patients reported that their arthritic symptoms were affected before and during weather changes, in particular during cold and damp weather conditions. Younger patients with chronic pain who had been told 'they had arthritis', tended to be most sensitive to weather changes. Weather sensitivity was unrelated to all other demographic variables and to geographic region. Cold and damp conditions were considered to influence pain the most. However, the perceived effect of weather on pain was not found to be related to regional climate. Thus, the belief that living in a colder climate worsens pain was not supported in this study.

Höppe et al. [13] conducted two independent weather-sensitivity surveys in Germany and Canada. In Germany, 1064 citizens were interviewed, of which 54% population thought they had a varying degree of influence of cold weather on their health. Joint symptoms comprised 40% of all the included symptoms in the questionnaire. In Canada, 1506 citizens were interviewed and 61% subjects considered themselves to be weather sensitive. Interestingly, joint-related symptoms comprised only 10% of the overall symptomatology in Canadian population in this study.

Hawley et al. [14] analysed the nature of seasonal symptoms, their prevalence, and differences among rheumatic disorders over a period of up to 24 years. They used a questionnaire assessment using the Seasonal Pattern Assessment Questionnaire (SPAQ) in 1424 patients with rheumatoid arthritis, osteoarthritis and fibromyalgia. About 50% of patients with rheumatic disease reported exacerbation of rheumatic symptoms by seasonal changes. Using circular statistics, the modal months for worse symptoms were December and January, and for best symptoms was July. However when pain and global severity measurements obtained over a 24 year period were analyzed, pain was slightly increased in the summer and global severity was not related to season at all. Even when patients who specifically reported worse symptoms in winter and best symptoms in summer were examined, no effect of season could be found. Hence the results of this study showed that seasonal variation of arthritic symptoms appeared to reflect perception rather than reality.

Inaba and Mirbod [15] conducted two surveys on the subjective musculoskeletal symptoms among male electricians working in the buildings under construction in winter (n=74) and summer seasons (n=83). They used a self-administered questionnaire to collect information on age, occupation, working habit, present illness, and subjective musculoskeletal symptoms. Mean age, occupational career and daily smoking of the supervisors were significantly higher than those of the other subjects. In general, prevalence rates of stiffness, numbness, pain, finger cold sensation, dull movement of the fingers, pain in the wrist, knee joint, pain and numbness in the foot and cold sensation in winter were significantly higher than those in summer. These results were marked especially in the workers compared to the supervisors. In winter, there were no significant differences in the prevalence rates of subjective musculoskeletal complaints between the supervisors and the other workers. On the other hand, in summer, prevalence of stiffness and pain in the shoulder, stiffness and pain in the neck, dullness and pain in the arm, finger cold sensation, low back dullness and low back pain in the supervisors were significantly higher than those in the other workers.

In a recent review article on the effects of weather in patients with rheumatoid arthritis, Smedslund and Hagen [5] suggested that many different weather variables have been studied in the past, but only three (temperature, relative humidity and atmospheric pressure) have been studied in more detail. Individual analyses from two out of the nine included studies indicated that pain reporting in a minority (< 25%) of RA patients was influenced by temperature, relative humidity or atmospheric pressure. Their findings did not show any consistent group effect of weather conditions on pain in patients with rheumatoid arthritis.

Discussion

It has been suggested that the belief that signs and symptoms of RA are influenced by weather might be due to individual's tendency to perceive patterns that don't exist [16]. Osteoarthritis is a multifactorial disease with complex etiologies involving hereditary, developmental, metabolic, mechanical and other factors. The disease progression involves a combination of abnormal mechanical stresses and biochemical imbalances that lead to a loss of proteoglycans, disruption of the collagen network and alterations in other joint tissues such as the synovium and subchondral bone [17]. Symptoms of rheumatoid arthritis, in particular, have been noticed to vary in severity due to seasonal variation. Environmental factors, such as temperature and moisture have been noticed to contribute to symptomatic worsening, but some other factors, such as levels of hormones, antibodies, inflammatory factors, and immune response could also be responsible for this trend [6].

The differences in stiffness are considered to become prominent with increasing age. The older the subjects, more stiff they become. Joint size may contribute to the changes observed up to the attainment of maturity but cannot explain increases in stiffness occurring after. The increase in stiffness may be related to changes in collagen, which the joint capsule is largely composed of. It is well known that there is alteration of collagen with advancing age, shown by increase in fibril width, greater thermal contraction, decreased susceptibility to collagenase and increased cross-linking [18-20].

The effect of temperature changes localized to the joint has been shown by increased stiffness at lower temperatures and decreased stiffness at higher temperatures. The latter effect probably accounts for the subjective benefit derived by arthritic patients from localized heat remedies. The contention that a significant part of the stiffness measured at the joint is attributable to the joint itself might be supported by these results. Here local temperature changes in the joint produce clear changes in stiffness while the temperature of more remote structures such as muscles remains constant [8,21-24].

Six studies reported association between worsening of arthritic symptoms with cold climatic conditions [4,8-10,12,13], however the remaining six studies did not show any convincing suggestion of this association [5,7,11,13-15]. There was a trend noticed towards worsening pain and stiffness with falling temperature and barometric pressure and increasing humidity in patients with arthritic disease, in particular rheumatic patients. Most of these studies were questionnaire-based interviews and hence the subjectivity of individual observation could not be quantified. Temperature and humidity were the most widely studied variables but varied with the geographical location of the individuals. There were many variations found between the methodology of the studies, their duration, participating subjects, climatic conditions and the extent to which the participants were

studied. In a study of smaller duration, only a small part of yearly temperature range could be studied to influence patient's symptoms. It is also possible that the variation in symptoms observed by the patients, in particular in cases of RA, was due to variations in disease severity rather than variations in weather variables. In order to study the effects of weather on joint symptoms, experimental studies should be designed to focus on evaluation of weather variables on objective assessment of disease variables, however, there are potential challenges of variation of daily exposure to outdoor weather and measures to control the indoor climate conditions.

Conclusion

The evidence to support the common belief and observation that cold climate worsens arthritic symptoms, is weak, however, some studies and experiments have shown that patients with arthritic symptoms do experience a trend of worsening in pain and stiffness in cold and damp weather. This is particularly noticed in rheumatoid patients and elderly patients with advanced degenerative changes in their joints. It could not be ascertained whether this was due to variation in perception of symptoms nor was there a scientific reason behind this common belief. It creates a potential for a well-structured study on human subjects with arthritis, the results of which might help to understand the pathophysiology behind this clinical observation, hence providing direction towards controlling the ailment in these patients either before or during extreme climate conditions.

References

1. Hill DF (1972) Climate and Arthritis; In arthritis and allied conditions, in A Text Book of Rheumatology, Philladelphia, Pennsylvania, USA. pp: 256-263.
2. Patberg WR (1987) Effect of weather on daily pain score in rheumatoid arthritis. Lancet 330: 386-387.
3. Laborde JM, Dando WA, Powers MJ (1986) Influence of weather on osteoarthritics. Soc Sci Med 23: 549-554.
4. Shutty MS Jr, Cundiff G, De Good DE (1992) Pain complaint and the weather: weather sensitivity and symptom complaints in chronic pain patients. Pain 49: 199-204.
5. Smedslund G, Hagen KB (2011) Does rain really cause pain? A systematic review of the associations between weather factors and severity of pain in people with rheumatoid arthritis. Eur J Pain 15: 5-10.
6. Schlesinger N, Schlesinger M (2005) Seasonal variation of rheumatic diseases. Discov Med 5: 64-69.
7. Jamison RN, Anderson KO, Slater MA (1995) Weather changes and pain: perceived influence of local climate on pain complaint in chronic pain patients. Pain 61: 309-315.
8. Wright V, Johns RJ (1961) Quantitative and qualitative analysis of joint stiffness in normal subjects and in patients with connective tissue diseases. Ann Rheum Dis 20: 36-46.
9. Hollander JL (1961) The controlled-climate chamber for study of the effects of meterological changes on human diseases. Trans N Y Acad Sci 24: 167-172.
10. Patberg WR, Nienhuis RL, Veringa F (1985) Relation between meteorological factors and pain in rheumatoid arthritis in a marine climate. J Rheumatol 12: 711-715.
11. Sibley JT (1985) Weather and arthritis symptoms. J Rheumatol 12: 707-710.
12. Guedj D, Weinberger A (1990) Effect of weather conditions on rheumatic patients. Ann Rheum Dis 49: 158-159.
13. Höppe P, von Mackensen S, Nowak D, Piel E (2005) Prevalence of weather sensitivity in Germany and Canada. Int J Biometeorol 49: 156-166.
14. Hawley DJ, Wolfe F, Lue FA, Moldofsky H (2001) Seasonal symptom severity in patients with rheumatic diseases: a study of 1,424 patients. J Rheumatol 28: 1900-1909.
15. Inaba R, Mirbod SM (2010) Subjective musculoskeletal symptoms in winter and summer among indoor working construction electricians. Ind Health 48: 29-37.
16. Redelmeier DA Tversky A (1996) On the belief that arthritis pain is related to the weather. Proc Natl Acad Sci USA 93: 2895-2896.
17. Mandelbaum B, Waddell D (2005) Etiology and pathophysiology of osteoarthritis. Orthopedics 28: s207-s214.
18. Verzar F (1957) The ageing of connective tissue. Gerontologia 1: 363-378.
19. Hall DA (1955) Collagen and elastin in connective tissue. J Gerontol 10: 388-400.
20. Keech MK (1955) Human skin collagen from different age groups before and after collagenase digestion; an electron microscopic study. Ann Rheum Dis 14: 19-50.
21. Tunbridge RE (1956) Heberden oration, the connective tissue system. Ann Rheum Dis 16: 6-15.
22. Wright V (1987) Biomechanical aspects of human joints. Z Gesamte Inn Med 42: 414-415.
23. Wright V, Dowson D, Seller PC (1971) Bio-engineering aspects of synovial fluid and cartilage. Mod Trends Rheumatol 2: 21-29.
24. Wright V, Dowson D, Unsworth A (1971) The lubrication and stiffness of joints. Mod Trends Rheumatol 2: 30-45.
25. Wright V, Johns RJ (1960) Physical factors concerned with the stiffness of normal and diseased joints. Bull Johns Hopkins Hosp 106: 215-231.