REVIEW

ACCEPTED: March 2022

PUBLISHED ONLINE: April 2022

Frey P-E, Schiltenwolf M. Chronic pain and exercise. Dtsch Z Sportmed. 2022; 73: 98-105. doi:10.5960/dzsm.2022.525

Frey P-E[1], Schiltenwolf M[1]

Chronic Pain and Exercise

Chronischer Schmerz und Bewegung

1. HEIDELBERG UNIVERSITY HOSPITAL, *Department of Orthopedics and Trauma Surgery, Heidelberg, Germany*

Summary

- **Problem:** Worldwide, at least one in four adults do not exercise sufficiently. Inactivity is associated with an increase in disease burden and mortality, whereas exercise can contribute to a longer, healthier life. Chronic musculoskeletal pain is a significant public health concern; in Germany, approximately 15% of the adult population suffers from chronic low back pain. Based on the diagnoses of chronic back pain, chronic joint pain, and chronic widespread pain or fibromyalgia syndrome, this study will evaluate the importance of exercise in the treatment of chronic pain.
- **Methods:** Narrative review based on current treatment guidelines and scientific publications.
- **Results:** Exercise and physical activity are both preventively and therapeutically effective in the treatment of chronic musculoskeletal pain. Individualized, supervised exercise programs that take patients' preferences and goals into account appear to be particularly effective, regardless of pain location. There is evidence that the positive biopsychosocial effects of movement are more important than the specific form of exercise.
- **Discussion:** In the treatment of chronic pain, exercise and activity should be considered primary therapeutic measures and be prescribed accordingly. Supervision and adaptation of exercise programs to patient needs are critical factors of success, regardless of the type of sport or form of exercise. Even a small dose of physical activity achieves health benefits in patients with chronic pain and contributes to symptom relief.

KEY WORDS:
Movement, Fibromyalgia, Back Pain, Joint Pain, Pain Therapy

Zusammenfassung

- **Problemstellung:** Weltweit bewegt sich mindestens ein Viertel der Erwachsenen zu wenig. Inaktivität geht mit einer erhöhten Krankheitslast und Sterblichkeit einher, während Bewegung zu einem längeren, gesünderen Leben beitragen kann. Chronische muskuloskelettale Schmerzen sind ein erhebliches globales Gesundheitsproblem, in Deutschland leiden etwa 15% der erwachsenen Bevölkerung an chronischen Schmerzen des Rückens. Anhand der Diagnosen chronischer Rückenschmerz, chronischer Gelenkschmerz sowie chronisch weit verbreiteter Schmerz bzw. Fibromyalgie-Syndrom soll ermittelt werden, welche Bedeutung Bewegung in der Behandlung chronischer Schmerzen zukommt.
- **Methoden:** Narrative Review-Arbeit auf Grundlage der aktuellen Behandlungsleitlinien und wissenschaftlicher Publikationen.
- **Ergebnisse:** Bewegung und körperliche Aktivität sind sowohl präventiv als auch therapeutisch wirkungsvoll in der Behandlung chronischer muskuloskelettaler Schmerzen. Individualisierte, supervidierte Übungsprogramme unter Berücksichtigung der Vorlieben und Ziele der Patienten scheinen unabhängig von der Schmerzlokalisation besonders effektiv zu sein. Es gibt Hinweise darauf, dass dabei die positiven biopsychosozialen Effekte von Bewegung wichtiger sind, als die konkrete Bewegungsform.
- **Diskussion:** In der Behandlung chronischer Schmerzen sind Bewegung und Aktivität als primäre Therapiemaßnahmen anzusehen und sollten entsprechend verordnet werden. Supervision und die Anpassung der Übungsprogramme auf die Patientenbedürfnisse sind entscheidende Faktoren des Erfolgs, unabhängig von Sportart oder Bewegungsform. Auch eine geringe Dosis an körperlicher Aktivität erzielt bei Patienten mit chronischen Schmerzen gesundheitliche Vorteile und trägt zur Linderung der Beschwerden bei.

SCHLÜSSELWÖRTER:
Aktivität, Fibromyalgie, Rückenschmerzen, Gelenkschmerzen, Schmerztherapie

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CORRESPONDING ADDRESS:
Pia-Elena Frey
Heidelberg University Hospital
Department of Orthopedics and Trauma Surgery
Schlierbacher Landstraße 200 a,
69118 Heidelberg, Germany
: pia-elena.frey@med.uni-heidelberg.de

Introduction

According to the International Association for the Study of Pain (IASP), pain is "an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage". Pain is considered chronic if it lasts longer than the usual 3-month period of tissue healing (57). Primary chronic – for example musculoskeletal – pain will also be included in the corresponding ICD-11 definition.

Chronic pain is a global public health concern which is associated with considerable economic costs and strain on health systems (4, 31). The BURDEN 2020 study determined that 61.3% of respondents in Germany suffered from back and 45.7% from neck pain at least once in the previous 12 months, with 15.5% of participants even reporting chronic pain of the lower back (96).

Physical activity in general is defined as "any bodily movement produced by skeletal muscle that requires energy expenditure" (101). This rather mechanistic consideration is based on the concept that activity in many different forms can contribute to health and well-being if it is practiced regularly, of adequate duration and with appropriate intensity (102). In addition to traditional aerobic exercise such as running, cycling or swimming, there are numerous types of sports and forms of combined relaxation and movement like dancing, yoga or tai-chi; one may be physically active even at home or at work.

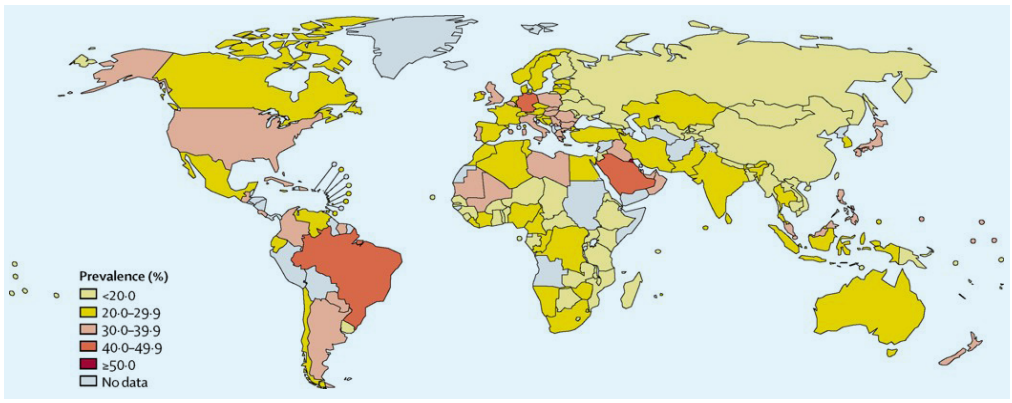

Figure 1

The prevalence of insufficient physical activity among men in a worldwide comparison of countries in 2016, Guthold R et al. (32), with permission.

However, people, especially in industrial nations, do not move sufficiently. The WHO recommends at least 150 minutes of moderate activity per week for adults and 60 minutes of moderate to intense activity daily for adolescents (102). Worldwide, these activity targets are not achieved by one in four adults and three in four adolescents (32, 102). The global financial burden for health care systems resulting from physical inactivity is estimated at 54 billion INT$ per year, which corresponds to at least 1 to 3% of national healthcare expenditure (21) (Figure 1 und 2).

Inactivity and sedentary behavior are associated with increased cardiometabolic disease burden and mortality (67). On the other hand, physical activity has been proven to contribute to a longer life with more quality-adjusted life years (QALYs) (54). For example, brisk walking (4.8 to 6.2 km/h) for at least 3 hours and vigorous exercise (≥6 metabolic equivalents per hour) for at least 1.5 hours per week could reduce the incidence of heart attacks in women significantly by 30 to 40% (53). In elderly people, regular exercise contributes to maintaining physical function and a longer survival – a clear dose-effect relationship could, however, not be determined (86).

Objective

When considering chronic pain, the question now arises: What kind of exercise and how much of it is actually beneficial and for whom? What forms of exercise can provide evidence-based pain relief? And what can motivate people to exercise and stay consistent on a day to day basis?

Results

There is proof that physicians focus mostly on mechanistic, biomedical origins when patients express pain. This may result in the primary prescription of drugs and analgesics without recommendations for exercise to maintain daily activities or analyzing potential biopsychosocial aspects (78).

Accordingly, many patients suffering from pain assume that the sensory experience of it must always occur due to some bodily impairment. This may be why a targeted, cause-related treatment is then demanded while biopsychosocial approaches to pain are rejected. However, the biopsychosocial model is essential in understanding the origin of chronic pain and the elaboration of treatment recommendations. Multidisciplinary approaches which consider psychological and social factors in addition to the prescription of exercise have been found to be particularly effective in chronic musculoskeletal pain (30, 94). Moreover, when therapeutic interventions are combined with patient education, they are even more effective in the reduction of pain and disability (61, 69). The assurance that the bodily tissues are sound and can be actively utilized results in additional positive effects (88). Patients need to develop self-efficacy, learn to actively intervene when they are confronted with painful sensations and take responsibility for their own bodies.

Physical activity is generally recognized as beneficial in the treatment of patients with chronic pain, which has also been adopted as a central recommendation in treatment guidelines (13, 20, 42, 66, 71, 76). There is widespread agreement especially for individualized exercise programs with focus on aerobic and resistance training which must respect the patients' complaints as well as their preferences (12).

So far, it remains unclear which type of movement is the most effective. In several studies, pain levels did not correlate with the actual improvement of physical functions (85). This finding may support the theory that secondary effects of training such as better mood, reduction of anxiety or improved self-efficacy have a greater influence on the experience of pain than the actual enhancement of physical capacities (e.g. range of motion, strength, endurance) (85, 98). Some studies indicate that the adherence to training recommendations is essential for the effect of the therapeutic intervention (37, 91). If, indeed, the positive biopsychosocial effects of training are paramount in chronic musculoskeletal pain, the question arises if the form of movement and its dose are perhaps less relevant than the performance of the physical activity itself.

Back and Neck Pain

Back and neck pain are widespread conditions. With a lifetime prevalence of up to 94% in certain sports such as rowing (89) and a more than 60% 12-month prevalence in Germany, at least every second person will suffer from back pain during their lifetime (96). At a global level, back pain results in more years lived with disability (YLDs) than any other disease (40). Precisely, low back pain was responsible for 60.1 million disability-adjusted life years (DALYs) worldwide in 2015, a 54% increase compared to 1990 (34). In Germany, 10.8% of YLDs in 2019 were attributed to low back pain – more than any other disease (23).

Although the symptoms of acute episodes rapidly improve in most patients, back pain becomes chronic in 4 to 25% of patients (58). High levels of pain, being overweight or obese, carrying heavy loads at work, physically demanding work in general, as ›

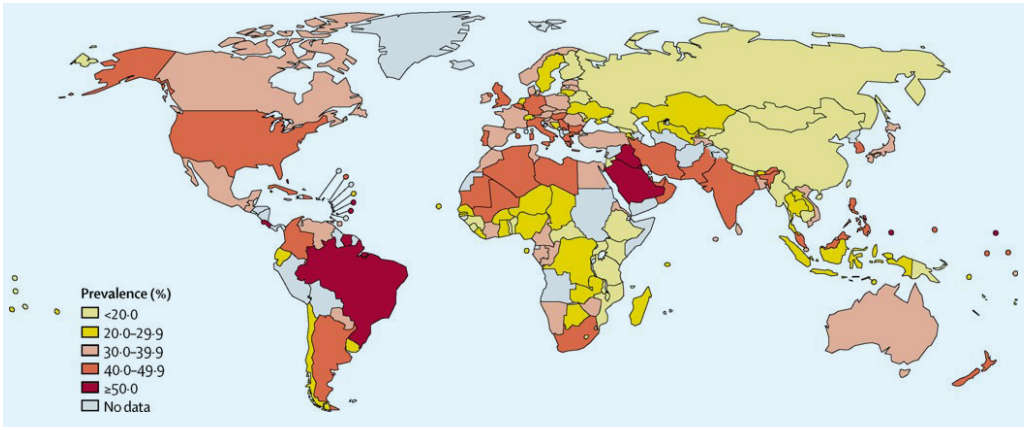

Figure 2

The prevalence of insufficient physical activity among women in a worldwide comparison of countries in 2016, Guthold R et al. (32), with permission.

well as psychological factors such as depression, anxiety and avoidance behavior are known risk factors of chronification (65). A sedentary, inactive lifestyle is associated with disability and a more intense experience of pain (39, 51).

Solid evidence has been established for the therapeutic benefits of exercise in back pain (36, 93). The German national treatment guidelines thus recommend the prescription of exercise therapy in combination with educative or behavior therapeutic measures (13). Interventions based on exercise are significantly more effective than alternative treatment methods (e.g. manual therapy, NSAR) in the reduction of pain and disability (37, 92).

However, forms of movement that put strain on the body such as heavy physical labor and extreme athletic activities are factors suspected to contribute to back pain (41, 47, 60). In particular, one-sided, asymmetric postures, lifting heavy weights, poor working conditions and bad weather are associated with a higher prevalence of back pain (77).

These apparently contradictory results support the hypothesis that an appropriate amount of physical activity is necessary to prevent and ameliorate back pain. Several studies indicate that the relationship between exercise and back pain may be best visualized as a U-shaped correlation, and that a moderate level of activity can reduce the risk of chronic low back pain (17, 38, 80, 82) (Figure 3). This relation appears to apply both in exercise performed during sports as well as at work. To be precise, 1 to 2.5 hours of exercise per week appear to significantly reduce the risk of chronic low back pain (38).

In a 2020 systematic review and meta-analysis, stabilization/motor control training, Pilates, resistance training and aerobic exercise were found to be most effective; the authors, however, explicitly voiced the necessity of further studies of higher quality (68). According to current knowledge, progressive endurance and resistance training appear to be equally beneficial for the perception of pain, physical function and quality of life, whereby strength training had an additional positive effect on emotional well-being (100). Walking in itself also appears to have a positive and comparable effect as training on pain, function, quality of life and avoidance behavior (95).

Multidisciplinary therapy approaches such as multimodal pain therapy appear to be superior to unimodal therapy approaches, especially in chronic pain (29, 45). Multimodal pain therapy is an integrative concept characterized by the close interaction of individual therapeutic components and the health professions involved along with high treatment intensity (62). A multidisciplinary team allows for the combination of activating interventions such as endurance, mobility or strength training with psychotherapeutic treatment approaches (patient education, cognitive behavior therapy) and medical as well as psychological one-to-one sessions, which has been shown effective on the long term (74, 106). It appears to be paramount that multiple factors are addressed in such a treatment setting and that the patient's biopsychosocial environment is considered (8, 25, 43, 73).

Joint Pain

Chronic joint pain, especially of the knee, is frequent and continuously increasing in prevalence, independent of age and BMI (27, 64). In a survey conducted by Robert Koch Institute, 57.9% of women and 52.2% of men reported episodes of joint pain in the preceding 12 months, more than one-quarter of them even within the preceding 24 hours; in most cases, pain was perceived in multiple joints at once (27). Osteoarthritis and rheumatoid arthritis are considered the most common causes of joint pain, but together they affect just under half of people with pain complaints (105).

The knee is the joint most often experienced as painful; in patients older than 60, knee pain is even the most common musculoskeletal pain in general, sometimes with no detectable signs of osteoarthritis (27, 55, 90). While the prevalence of knee pain has been increasing in recent decades, the proportion of radiological signs of osteoarthritis of the joint has not (64). In young adults suffering from unspecific pain of the knee, chronification has evolved in about 20% of the patients over a period of 6 years (46).

Recreational sports appear to have a protective effect in the development of knee pain, and being physically active in their leisure time did not correlate with the risk of hip and knee arthrosis in elderly and middle-aged people (1, 7, 24). In contrast, very high levels of physical strain, especially on the job, seem to increase the risk of chronic knee pain (82, 87).

Being overweight or obese, female gender and previous trauma to the joint are among the main risk factors for developing knee pain; about 5% of new-onset knee pain can be attributed to injury and about 25% to excess body weight (81). Therefore, weight loss is a relevant therapeutic tool in the treatment and prevention of knee pain in overweight and obese patients (59). A reduction in body weight by 10% appears to result in lasting pain relief (99). In addition to nutritional medical support, movement and exercise are key factors for achieving and maintaining a healthy body weight.

These findings are also reflected in the treatment guidelines for knee osteoarthritis which strongly recommend (guided) endurance and resistance training based on current evidence (9, 19, 26). An additional primary treatment recommendation are physiotherapeutic measures to strengthen the muscles surrounding the joint (19, 70). For the best effect, a systematic review on knee osteoarthritis in 2014 recommended supervised training three times a week, which should focus on the improvement of aerobic capacity, performance of the lower extremities and

strengthening especially of the quadriceps muscle (44). It is recognized that exercise in itself has beneficial effects on pain and function, but larger randomized controlled studies analyzing the impact of specific training forms and their long-term effects are imperative (63).

Finally, the biopsychosocial model is also applicable for chronic pain of the joints and should be implemented in diagnostic and therapeutic measures. Patients with osteoarthritis do also benefit from the promotion of self-efficacy, composure and resilience (72).

Chronic Widespread Pain and Fibromyalgia Syndrome

The point prevalence of chronic widespread pain as part of the fibromyalgia syndrome in Germany is 2.1% (104). To diagnose chronic widespread pain, by definition, it must occur in multiple parts of the body or at least 11 of 18 specific tender points must be sensitive to pressure (22). Apart from chronic pain, the fibromyalgia syndrome is characterized by insomnia or non-restorative sleep, along with fatigue and exhaustion (76). The pain usually manifests as myalgia in alternating localizations, back pain or joint pain (35).

Aerobic exercise has been shown to be effective in relieving pain, improving overall well-being and body function (10, 56, 103). In a systematic review comprising 16 randomized studies, aerobic training was found to be superior to resistance training with respect to relief of pain and symptoms (14). However, with supplementary strengthening and stabilizing exercises at low to moderate intensity, fatigue and health-related impairment could be significantly reduced (16). Aquatic exercise resulted in significant improvements in pain, insomnia and disability (50) and was superior to land-based training concerning the reduction of pain levels (11). Sports with spiritual and mental elements such as yoga can also be beneficial (49). In current meta-analyses, aerobic as well as resistance training are currently considered the most effective interventions regarding pain relief and improvement of overall well-being; moreover, stretching and endurance exercises may improve health-related quality of life (10, 83). However, the authors emphasize that it is not possible to recommend specific forms of training based on the data currently available.

Multimodal therapy is considered effective in the short and long-term and recommended in current treatment guidelines for patients with fibromyalgia syndrome (76). Such a program should comprise at least 24 hours of treatment as significant effects on pain, fatigue and quality of life can only be achieved with an appropriate volume of therapy (76).

Discussion

The majority of people are not as active as they should be. In order to prevent disability and promote self-efficacy by prescribing active treatment modalities, it is essential to motivate patients to exercise and move early on. Passive measures of therapy and the prescription of bed rest have been proven ineffective (3, 52, 97) while instructed exercise is not less effective than, for example, the referral to manual therapy (33).

Exercise may initiate complex neurobiological pathways which leads to the endogenous release of endorphins, stimulates opioid receptors and thereby enables direct analgesic effects (79). In animal models, training on a regular basis caused sustainable anti-nociceptive effects (84). The specific modality of movement appears to be less important than the steady encouragement of patients with chronic pain to maintain activity and exercise regularly on the long term. It must be considered the physician's responsibility to combat lethargy and passivity and educate patients thoroughly about the multiple benefits of exercise.

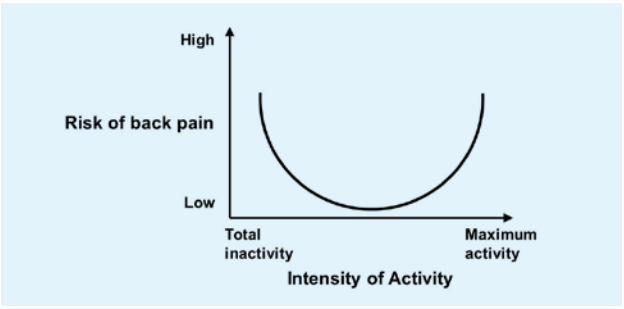

Figure 3

U-shaped correlation between back pain risk and activity. Adapted from Heneweer, Vanhees and Picavet (2009).

An individual optimum of the amount of exercise depending on physical constitution, age and personal preferences should be determined for everyone. Patients who enjoy exercise and do so to achieve their individual goals have been shown to be more adherent to training interventions (42). Conversely, the correlation between mental illness and chronic pain has been known for years (18) and pain intensity over time is less influenced by nociception than by emotional and psychosocial factors (6).

On the basis of biopsychosocial considerations, activity should be integrated into the patient's respective private and occupational environment. For example, avoiding motorized transport in favor of cycling and walking will facilitate the achievement of daily activity goals. In general, even a small dose of physical activity can protect against chronic pain and is associated with health benefits in affected patients (28, 75), e.g. 20 to 60 minutes of aerobic exercise at least 2 days per week (15, 66). As higher-intensity exercise (>/= 70% HRmax/1RM) can also relieve pain and improve function, patients with chronic pain who prefer more intense training modalities should be motivated to do so as well (9, 48). Even though the evidence for aerobic exercise and resistance training is very good, any sport that patients enjoy and that maintains motivation for exercise should be considered (12).

Adherence also appears to be less influenced by the specific type of exercise (2, 42). Bachmann, Oesch and Bachmann determined the following aspects as relevant to a patient's adherence to home exercise programs in a 2018 systematic review: family and social support, guidance, limited number of exercises (3 and less), self-motivation, self-efficacy, previous adherent behavior, level of physical activity and aerobic endurance at baseline, attentiveness, worsening of pain during exercise, and the degree of helplessness, depression and anxiety (5). Supervised as well as individualized exercise programs appear to be particularly effective for chronic musculoskeletal pain and can help to effectively increase weekly exercise frequency (42).

The prescription of physical activity should allow patients to develop body awareness by testing and pushing their own limits, build self-efficacy, and take individual needs into consideration. Especially for patients with chronic pain, it has been shown to be helpful to repeatedly reassure them that structures are sound and that exercise is safe (88). In this context, exercise therapy should be seen as a supportive measure intended to help patients become more active on their own. They should become introduced to sports and exercise, with a focus on reducing fear of movement and promoting self-efficacy.

Conflict of Interest

The authors have no conflict of interest.

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