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Review Article

Does Diabetes Increase Joint Pain? - A Review

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Abstract

Introduction

Diabetes mellitus (DM) consists of a group of metabolic diseases characterized by hyperglycaemia or elevated levels of blood glucose. People with diabetes suffer from a number of disorders that can cause dysfunction and joint pain, which can reduce their quality of life. The aim of this review is to discuss if diabetes increases joint pain. This review also looks at the mechanisms through which diabetes contributes to joint pain.

Joint pain is one of the main causes of disability worldwide. Changes to joints include lessened ability to move joints, joint swelling, deformities, tenderness, stiffness, warmth, redness and swelling. Although often mild, the pain can be severe, which can make it hard to move the joint. Diabetes and obesity have been found to influence arthritis pathology. There is evidence that macrovascular and microvascular complications of diabetes could be responsible. Additionally, inadequate control of diabetes can affect the bones and muscles, damage nerves and cause joint pain and other symptoms over time.

Diabetes has been found to have associations with diseases such as Osteoarthritis (OA), Rheumatoid arthritis (RA), gout and joint pain. Some studies have shown that abnormal glucose metabolism and inflammation could be associated with joint pain, which may cause decreased joint function in diabetes, however, it is not clear whether diabetes increases joint pain. Future studies of diabetes influenced mechanisms may help us to better understand the underlying causes of joint pain for effective therapies, which can improve patient care.

Keywords: Diabetes mellitus; Gout ; Hyperglycaemia; Joint pain; Osteoarthritis; Rheumatoid arthritis

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Introduction

Diabetes mellitus (DM) consists of a group of metabolic diseases characterized by persistent hyperglycaemia or elevated levels of blood glucose [1]. It is one of the most common chronic diseases and the World Health Organization (WHO) estimated that about 422 million people have diabetes worldwide [2]. Persistent hyperglycaemia has been found to have an association with long-term damage, dysfunction and failure of different organs, such as the nerves, blood vessels, eyes, heart and kidneys [1]. Evidence suggests that macrovascular and microvascular complications of diabetes could be responsible [3]. Diabetes is broadly classified under two categories. Type 1 diabetes mellitus (T1DM), which is caused due to a total deficiency of insulin secretion and type 2 diabetes mellitus (T2DM), which is the most common form and comprises of about 90-95% of those with diabetes [1]. In diabetes, studies have found an increased risk of various bone and joint disorders that may cause joint pain [4]. This review looks at the effects of diabetes on joint pain in order to better understand the underlying causes and mechanisms. Joint pain may increase in people with diabetes which may result from several factors, which are also discussed in this review.

Diabetes and Joint Pain

Joint pain is one of the main causes of disability worldwide. Diabetes can affect bones and muscles and damage nerves, which may lead to joint pain and other symptoms [1]. This can make it hard to move the joint and although not very clear, the intensity of pain can be variable. Patients with diabetes may develop several conditions involving the bones and muscles, many of which have an association with the duration and severity of the disease [5]. Other than soft tissues, muscles, tendons or nerves, these conditions may also affect the joints. Changes to joints include lessened ability to move joints, joint swelling, deformities, tenderness, stiffness, warmth, redness and swelling. These changes can cause many conditions that may affect the hands, wrists, fingers, neck, feet, shoulders or spine, which can cause pain and loss of function [4]. Joint pain is one of the main complaints of people who have arthritis. It is estimated that about 9.3 million working days are lost in the UK, most commonly due to pain in the hips, back and knees [6]. Age, body mass index (BMI) and gender have been found to have significant associations ($p<0.001$) with pain [7].

Diabetes and Arthritis

Arthritis has been defined as an acute/chronic inflammation of the joint that usually co-exists with structural damage and pain [8]. An estimated 10 million people live with the condition in the UK alone [9] and in the United States (US), over one-third of people have arthritis [8]. The common symptoms of arthritis are pain, swelling, stiffness, weakness, deformity, instability and loss of function, which may lead to limited movement and pain in the affected joint [8]. About half (47.3%) of patients with diabetes have some form of arthritis, which are closely associated with the type of diabetes [9]. Researchers have explored the relationship between diabetes and the risk of arthritis.

A systematic review and meta-analysis found that the overall association between diabetes and arthritis was 1.61 (95% confidence interval [CI] 1.14, 2.28; p=0.007) [9]. The findings suggested that diabetes is more likely a comorbidity of arthritis rather than a risk factor [10]. These findings are similar to another study which found that diabetes is a comorbidity of Osteoarthritis (OA) in elderly patients [11]. Recent studies have found that diabetes is associated with increased odds of having OA and also osteoporosis and Rheumatoid Arthritis (RA) [7]. Some studies have found that people with T1DM have a significantly higher risk of having RA, while people with T2DM have a higher risk of developing OA and gout [8]. People with diabetes have also been found to be at high risk for adhesive capsulitis and shoulder pain [7, 12]. However obesity may also increase the risk of T2DM as well as these forms of arthritis [8].

Diabetes and Osteoarthritis

Osteoarthritis (OA) or degenerative arthritis is a joint disorder and the most common form of arthritis [8]. The WHO estimated that 25% of adults over 65 years globally suffer from pain and physical disability associated with OA [13]. OA affects around 8 million in the UK [9] and is caused when the joint cartilage breaks down. Although it may mostly affect the back and the lower limbs, it may have an effect on any joint in the body. OA may cause symptoms such as joint pain, stiffness and swelling, along with loss of movement or joint flexibility [8]. Several studies have examined the role of diabetes in OA, including OA progression and pain. A recent systematic review found a high frequency of OA exists in patients with diabetes [14]. Diabetes was found to have an association with OA (adjusted OR 1.3; CI 1.2, 1.4; p<0.001) [7]. A previous study had found a higher incidence of OA in young and middle aged patients with diabetes, with joint damage starting at an earlier age [15]. However, some studies have found that OA and T2DM often seem to co-exist in older adults [16, 17]. A systematic review and meta-analysis found an association between T2DM and OA development and progression in observational studies [18]. A cohort study confirmed that diabetes has a negative effect on OA and it either increases prevalence or the progression rate [19]. In contrast, a previous study had found no association between T2DM and OA in a cohort of patients with OA [20]. However, a recent cohort study of middle aged individuals without diabetes found that OA in the knees or hips were independent predictors of incident diabetes [21]. The effect of diabetes on OA progression was recently studied in a cohort of 559 individuals with knee OA. 6.6% of the participants had T2DM, and diabetes was identified as an independent risk factor for knee OA progression [16]. Another study showed that people with diabetes and knee OA were 2.45 (95% CI 1.07, 5.61) to 2.55 (95% CI 1.12, 5.79) times more likely to have knee pain compared to controls [22].

Diabetes and Osteoporosis

Diabetes has been found to be associated with osteoporosis (adjusted OR 1.2; CI 1.1, 1.4, p=0.010) [7]. Both T1DM and T2DM had associations with a higher risk of fractures [23]. In T1DM, the risk was increased by approximately 6 times, which was likely to be because of low bone mass [23]. A systematic review reported that T2DM was associated with osteoporosis and bone mineral density (BMD) [24]. T2DM was associated with an increased the risk of hip fracture in males (Relative Risk (RR) 2.8; 95% CI 1.2, 6.6) and also in females (RR 2.1; 95% CI 1.6, 2.7) [24]. Although BMD is higher in patients with T2DM, the risk is about twice the risk compared to the general population [23]. A Singaporean cohort study reported that chronic joint pain was independently associated with spinal osteoporosis (Relative Risk Ratio (RRR) 4.12; 95% CI 1.53, 11.07) [25].

Diabetes and Rheumatoid Arthritis

Rheumatoid arthritis (RA) is an autoimmune disorder where chronic synovial inflammation of multiple joints occur [26]. It is characterized by joint pain, loss of function and decreased Quality of life and patients often need joint replacement with disease progression. About 1% of Caucasians have been found to have RA and females are affected more compared to males [27]. RA has a disease prevalence of about 5% in females over the age of 65 [27]. RA causes mainly the joints of the wrists, hands and feet, to be swollen, difficult to move and painful [8]. The prevalence of patients who had RA and diabetes was found to be about 15%-19%, which is significantly greater compared to the worldwide incidence rate [28]. Several studies have shown that having T2DM increases the risk of developing RA and conversely, having RA increases the risk of developing T2DM. In a large database study, people with RA were found to have an approximately 50% increase in the risk of diabetes [28]. RA has been found to be associated with abnormalities in glucose metabolism, insulin resistance (IR) [29] and pro-inflammatory cytokines in T2DM, as observed in bone damage in RA [30]. Another study found that T2DM was associated with an increased risk of having RA in females [31]. RA and T1DM are both autoimmune diseases. Some researchers have found that people with T1DM have a higher chance of developing the condition [27]. RA causes the body's immune system to mistakenly attack and destroy the lining of joints in the long term [9]. In contrast, other studies have found no evidence that RA is common in patients with T1DM [32]. Some specific genes have been found to be associated with T1DM and RA, such as variants of the genes PTPN22, TNFAIP3, CTLA4, which were linked with a higher susceptibility to T1DM and RA [27].

Diabetes and Gout

Gout is a form of arthritis which causes sudden attacks of severe pain and inflammation around the joints. It affects more than 8 million people in the US and has a prevalence of 3.9% [33] and is the most common inflammatory arthritis in adult males. In Caucasians, gout was found to have an incidence rate of 1%-2% and the prevalence in patients with T2DM was 22% [34]. Associations between gout and T2DM have been found in a number of studies. A study showed gout to be associated with a 70% increased risk of developing T2DM [34]. Studies have found that gout is caused by a build-up of high levels of uric acid [33]. Diabetes has also been found to have associations with increased uric acid levels. Prolonged hyperuricemia leads to deposition of uric acid in the joints, which may lead to joint inflammation and cause pain. The presence of fibroblasts with proliferations were revealed, that lead to thickening of the capsule and synovia [35]. Studies have indicated that they develop due to chronic inflammatory infiltration, cytokine-mediated inflammation macrophages and T-cells [3,36].

Diabetes and Charcot's Joint

Charcot's arthropathy or Charcot's joint is also known as neuropathic arthropathy. Charcot's disease or joints, is a result of diabetic peripheral neuropathy [35]. It causes a joint to break down due to diabetic nerve damage. Charcot's joint is also found in other

conditions, however, it is commonly found in patients with diabetes. The incidence of Charcot's joint in diabetic neuropathy was about 10% [3]. Charcot's joint is mainly seen in the feet and ankles in people with diabetes. In diabetes, nerve damage in the feet is common, which may lead to Charcot's joint causing deformation that is usually found in the arch of the foot [3]. A loss of nerve function can lead to numbness and people are more likely to twist and injure ligaments when walking. This causes the joints to have added pressure, ultimately leading them to break down.

Diabetes and Frozen Shoulder

Frozen shoulder (FS) Adhesive capsulitis (AC) is a condition characterized by shoulder pain and limited range of shoulder mobility, which leads to functional disability [37]. It leads to contracture of the joint capsule and occurs in a painful and progressive manner [38]. Previous studies have shown an increased prevalence of FS in patients with diabetes compared to people without diabetes. A study found that the incidence of FS was 11% among patients with diabetes [39] and another found the prevalence to be about 11%-19% in patients with diabetes compared to 2%-3% in controls (37). People with diabetes are twice as likely to suffer from FS [8]. The incidence of FS has been found to increase with age and duration of the disease, in both T1DM and T2DM.

Diabetic Cheiroarthropathy and Dupuytren's Contracture

Diabetic cheiroarthopathy, also known as limited joint mobility syndrome, is a disorder in which the skin on the hands becomes thickened and waxy, and can cause pain in the joints. It is a long term complication of diabetes. In a study that assessed 233 patients with T2DM, limited joint mobility was present in 34% [40]. Limited joint mobility and Dupuytren's contracture are commonly found in the same patient [41]. Dupuytren's contracture is a deformity in which one or more fingers are bent toward the palm, with restricted joint movement, which can cause joint pain. A study found that amongst patients with Dupuytren's contracture about 13-39% had diabetes [42]. However, no association was found between diabetic control and the severity of contractures [42].

Diabetes, Obesity and Joint Pain

Obesity is one of the biggest factors that increase the susceptibility to arthritis. Arthritis occurrence with obesity and diabetes has been commonly observed worldwide [39]. Obesity and T2DM are two common co-morbidities that occur together and have been found to be closely associated with OA [42]. A close correlation of obesity has been found with OA [39] and also with BMD [39]. The pressure of excess weight on the joint cartilage is an important risk factor for the development of OA [43] as it can initiate the degeneration of cartilage [39]. Obesity is also an important risk factor for the progression of knee OA [44]. Other than OA, various studies have found strong correlations of obesity and diabetes with RA and gout. Studies have found strong associations between gout, serum urate concentrations, abdominal obesity and diabetes [3]. Serum uric acid has been found to be positively associated with BMI and obesity is a modifiable risk factor in the pathogenesis of gout [45]. An investigation into the higher prevalence of diabetes in patients with RA confirmed that obesity, lifestyle factors and comorbidity were the main underlying factors [46].

Inflammation and Joint Pain

T2DM has been associated with chronic, low-grade inflammation, which could possibly trigger the progression of inflammatory diseases such as RA. RA has been found to cause chronic inflammation and IR. In obesity, an increased production of a wide range of inflammatory molecules such as leptin, tumor necrosis factor-alpha (TNF-alpha), resistin and interleukin-6 (IL-6) have been found, which possibly contributes to IR [47]. A low-grade inflammation has also been found to exist in OA [17]. Magnetic resonance imaging studies have shown a relationship between inflammatory changes in the joint and pain, suggesting that OA pain is driven by inflammation [11]. Researchers have suggested that the persistent inflammatory state in RA might also be associated with the glucose metabolism dysfunction [31]. Patients with T2DM, arthritis and osteoporosis have been found to have persistently higher levels of the nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB), which controls DNA transcription and the production of cytokines and is likely to increase cellular responses to inflammation [48].

Hyperglycaemia and Joint Pain

Inadequate glycaemic control has been found to have an association with higher pain severity in patients with T2DM and OA [49]. A study found that in patients with RA, the incidence of abnormal glucose metabolism was considerably higher than the general population [31]. They found that the abnormal glucose metabolism in RA was linked with IR, islet beta cell apoptosis and inflammatory cytokines [31]. An older study had observed a marked thickening of per articular collagen in diabetic cheiroarthopathy, which they had suggested could possibly be due to the glycosylation of collagen [50]. Hyperglycaemia produces advanced glycation end products (AGEs) [51]. AGEs are permanently deposited glyco-oxidation products that are harmful compounds formed in the bloodstream due to the combination of protein or fat with sugar and can accumulate anywhere in the body, including joints [52]. Studies have suggested that joint pain in patients with diabetes may be caused by AGEs that collect in joints and the tissues around them [7, 38]. A recent retrospective study has shown that increased glycated hemoglobin (HbA1c) was significantly associated with higher pain severity (β 0.36; 95% CI 0.036, 0.67, p=0.029), after controlling for BMI, gender, age, OA and medications [49].

Pro-inflammatory Cytokines

Although OA has traditionally been classified as a non-inflammatory arthritis, an excess of ongoing immune processes within the OA joint and synovium has also been recognized. Cytokines are small proteins that are secreted from cells and influence communications and interactions between cells. Certain pro-inflammatory cytokines such as, IL-6 and TNF-alpha have been found to be involved in pain [30]. A number of independent studies have reported the association of multiple immune-regulatory components, including TNF-alpha and IL-6 in RA, IR and T2DM [53,54]. TNF-alpha is a pleiotropic cytokine that mediates autoimmune diseases, IR, inflammation, arthritis, immunomodulation, apoptosis and other pathological conditions [53]. Increased concentrations of TNF-alpha were found in acute and chronic inflammatory conditions (for example, RA, trauma, sepsis, infection), which caused a move towards a proatherogenic lipid profile and impaired glucose tolerance [54]. Moreover, patients with high-grade inflammation and high-sensitivity C-reactive protein >1.92 mg/litre, were found to be more insulin resistant than patients with low-grade

inflammation [55]. These factors were identified to have an important role in glucose metabolism in RA [55].

Connective Tissue Physiology in Diabetes

A few studies have reported changes in connective tissue physiology in diabetes [56]. Studies have found that hyperglycaemia and alterations in lipid metabolism might have a direct impact on subchondral bone and cartilage health that contribute to the development and/or progression of OA [17] and may also cause joint pain. Animal studies have found that diabetes increases proteoglycan catabolism in non-articular connective tissues [57]. OA is also known as degenerative arthritis because the proteoglycans and collagen in the cartilage at the joints start degrading. This causes fibrillation, erosion and cracking in the cartilage and form large erosions [58] that can cause loss of function and increased pain.

Diabetes and Arthroplasty Outcomes

Joint arthroplasty changes or replaces a joint in the body, mainly to restore normal movement and relieve pain in a deformed or diseased joint, such as the knee, hip, elbow, ankle or shoulder. In the US, about 200,000 hip joints are replaced every year [59] and arthroplasty rates are higher in people with diabetes [18]. A large cohort study showed that diabetes is an independent predictor of severe OA requiring joint arthroplasty [59]. T2DM was found to be a risk factor for OA progression and had a negative impact on arthroplasty outcomes [59]. The rates of total joint arthroplasty increased in patients with diabetes and the odds ratios (ORs) were statistically significant, ranging from 1.2 to 3.4 [59]. The researchers concluded that T2DM predicts the development of severe OA, which are independent of age and BMI. A patient's glycaemic control was also found to affect complications in patients with uncontrolled diabetes who had undergone arthroplasty than patients with controlled diabetes who had undergone arthroplasty [18].

Diabetes and Pain Intensity

In OA, mobility problems have been found to increase with increasing pain [52]. A recent study found that diabetes significantly increased pain intensity of knee OA [11]. A higher Knee Injury and Osteoarthritis Outcome pain score was obtained in patients with diabetes ($p<0.001$) compared to patients without diabetes and their knee joints had significantly higher synovitis scores ($p=0.024$) [11]. Significantly higher concentrations of IL-6 were also found in the synovial fluid (SF) ($p=0.003$) of patients with diabetes than knee joints from patients without diabetes [11]. Diabetes was associated with increased hand pain in erosive OA and worsening of pain due to OA was likely to have been due to diabetes [11]. In another study of 530 patients with hand OA, the pain scores were found to be higher in a subset analysis in patients with diabetes and erosive OA [60]. However, the field lacked an accepted criterion for the classification of erosive OA, so these results may not be reliable [60]. Recent studies have shown that T2DM has an association with higher pain severity in patients with OA [22, 49]. A recent cross sectional study has found that diabetes had a significant association with increased knee pain severity over seven days and over thirty days after adjusting for all covariates, including BMI, age and gender [22]. These findings are supported by a recent retrospective study, which also reported that T2DM was significantly associated with increased pain severity [49].

Discussion

Joint pain seems to be a frequent problem in patients with diabetes, as it is reported more often by people with diabetes compared to the general population. Age, BMI and gender have been found to have significant associations with pain [7]. The Arthritis Foundation reported that patients with diabetes are almost twice as likely to develop arthritis [1]. In patients with diabetes, the prevalence of arthritis increased with age and BMI and was higher in sedentary adults and females compared to controls [39]. There is evidence that various types of arthritis may affect the joints. Associations have been found between diabetes and joint pain and disorders such as OA, RA, Charcot's foot, frozen shoulder and gout. Evidence suggests that macrovascular and microvascular complications of diabetes may be responsible [3, 39]. Diabetes causes a disturbance in insulin metabolism that leads to hyperglycaemia, which may lead to systemic changes in body organs including joints [22]. In FS, contracture of the joint capsule occurs which reduces the joint volume and has been linked with inadequate control of diabetes [38]. Several studies have examined the role of diabetes in OA, including OA progression and pain. Two recently published systematic reviews and meta-analyses found a significant association between diabetes and OA [14, 61]. In contrast, a previous study had found no increase in diabetes among patients who had OA [62]. Additionally, in a cohort of OA patients, no relationship was found between T2DM and OA, even after adjusting for confounders for OA [20]. However, a recent study has indicated that T2DM is likely to be a risk factor for OA progression [63].

Evidence suggests that changes in hyperglycaemia and lipid metabolism may have an effect on subchondral bone and cartilage health that contribute to the development and/or progression of OA [17]. Recent research suggests that hyperglycaemia may directly affect bone and cartilage health partly due to AGEs. There is evidence that AGEs play an important role in the progression of diabetes complications [64]. Studies have indicated that pain in people with diabetes is found in joints [7] and around and are caused by AGEs [11,38]. AGEs can accumulate in the joints, which may increase bone fragility and cartilage stiffness [50]. In diabetic cheiroarthopathy, thickening of periarticular collagen was observed, which was possibly due to glycosylation of collagen [51]. Degradation of collagen and proteoglycans in the cartilage at the joints causes fibrillation, erosion, cracking and large erosions in gout, which may increase pain [58]. A cohort study confirmed that chronic joint pain had a significant association with osteoporosis [25]. T1DM and T2DM have both been found to be associated with osteoporosis [23]. Diabetes can lead to reduced bone strength and decreased bone quality. Diabetes was found to have an association with reduced bone strength [24]. Some studies have suggested that pain as a result of osteoporosis may have an association with T2DM [7,48]. An increased risk of fractures in T2DM could be because bone fragility is likely to depend on reduced bone quality rather than a reduction in bone mass [23]. However, the US Food and Drug Administration (FDA) has stressed that some diabetes medications such as the dipeptidyl peptidase-4 (DPP-4) inhibitors may cause/increase joint pain in some patients [65,66]. Additionally, joint and/or bone pain accompanied with fever in a patient with diabetes could be due to osteomyelitis or septic arthritis [67].

Studies have suggested that hyperglycaemia may induce chronic inflammation that can lead to changes in the joints [22,68] and may cause pain. Researchers have indicated that chronic low-grade

inflammation is observed in patients with T2DM that could contribute to the development of RA. Some studies have confirmed that in gout, chronic inflammatory infiltration, cytokine-mediated inflammation macrophages and T-cells cause fibroblasts with proliferations to develop, that lead to thickening of the capsule and synovium. These are likely to cause joint cavity contraction and pain [3, 36]. Pro-inflammatory cytokines were found to play an important role in beta-cell destruction in patients with RA and T2DM [30]. Evidence from observational studies suggests that pro-inflammatory cytokines may also have a role in Charcot's joint [3], as they mediate an excessive inflammatory response to traumas [69]. Another study emphasized that T2DM has a negative effect on OA through important pathways that involve inflammation and oxidative stress, which result from insulin resistance and chronic hyperglycaemia [63]. Persistently higher levels of NF-κB have been found in patients with T2DM, arthritis and osteoporosis, which may increase oxidative stress and cellular responses to inflammation [48].

In patients with diabetes, being overweight and obesity have been found to be important factors in the development of OA [7]. A systematic review confirmed that T2DM had an association with osteoporosis, BMD and also obesity [24]. Metabolic factors such as obesity and dyslipidaemia can give rise to inflammation, which leads to increased risks of T2DM and OA [70]. Studies have observed an increased production of a wide range of inflammatory molecules such as TNF-alpha, leptin, resistin and IL-6 in obesity, which is likely to contribute to IR [47] and cause or increase pain. In contrast, a study reported an involvement of obesity but not of diabetes in pain [71]. Obesity has been found to cause long-term harmful effects on the knee joint and obesity and diabetes were found to be closely associated with OA [39]. An increased bodyweight puts excess pressure on the joints, which leads to the development of OA [11]. This may cause joint pain, which can increase with prevalence or progression of the disease. However, it was unclear whether diabetes alone or obesity associated with diabetes is an important factor in determining the intensity of OA pain.

The findings from a large cohort study indicated that diabetes is harmful for knee and hip joints, independent of age and BMI and can lead to advancing destruction and joint failure [59]. The study confirmed a consistent and significant association between T2DM and OA, considering joint failure, as determined by arthroplasty and severity of joint changes [59]. A number of studies have examined the influence of diabetes on pain severity in patients with OA. The severity of pain was reported to be higher in patients with diabetes and OA [11,22,49,59,60,72]. Diabetes has also been found to have a negative impact on knee pain [11,22,49,72]. A recent study confirmed that diabetes increased the intensity of pain significantly in those who had knee OA [18]. In patients with diabetes, stronger sinusitis demonstrated higher pain intensities [11]. Furthermore, a positive association between pain intensities and levels of IL-6 was found which was likely to be dependent on diabetes and/or synovitis [11]. These results have been supported by a recent cross-sectional and a retrospective study, which showed that diabetes was significantly associated with increased knee pain severity [22,72]. Research has also shown that the number of comorbidities is associated with higher knee pain in knee OA [73]. Diabetes and obesity were among the comorbidities that were found to have an association with increased pain severity [74,75].

Future Implications

Diabetes seems to be an important factor in joint pain and there is evidence that diabetes increases joint pain significantly. The link between OA and T2DM suggests that alterations in glucose metabolism directly affect joints and adequate control of glucose metabolism may slow down the development of OA. Further investigation of diabetes in patients with OA could help identify the increased risk of pain as well as develop preventative therapies. Better glycaemic control might help with pain management in people with T2DM and OA. Inflammation seems to play an important role in diabetes, which could help us to better understand the mechanisms involved that lead to increased joint pain associated with these diseases. The findings regarding inflammation and oxidative stress could open a way for the development of new treatments and for reducing the prevalence of these diseases in future.

Conclusion

In conclusion, joint pain is one of the main causes of disability worldwide. Changes to joints include lessened ability to move joints, joint swelling, deformities, tenderness, stiffness, warmth, redness and swelling. Although often mild, joint pain can also be severe and can make it hard to move the joint. Diabetes can cause joint pain in various ways, which includes causing damage to the joints or nerves. The common risk factors, causes and emerging underlying links between joint pain and diabetes have been discussed in this review. Diabetes has been found to be associated with conditions such as OA, RA, gout and joint pain. With inadequate control of diabetes, higher levels of complications may result. Recent evidence suggests that joint pain can increase in diabetes and is associated with decreased joint function. However, these associations have been mainly supported by epidemiological studies and prospective case-control studies are needed to establish the true prevalence. A better understanding about the disease interactions could decrease medical costs associated with arthroplasty and other surgeries in patients who have diabetes as comorbidity. Future studies of diabetes influenced mechanisms may help us to better understand the underlying causes of joint pain for specific and effective therapies, which can improve patient care.

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Conflicts of Interest

None.

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