

# Prevalence of Neuro-Musculoskeletal Complications in Patients with T2DM

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## Abstract

Diabetes mellitus affects normal metabolizing body function and causes long term organs dysfunctions like blindness, kidney failure, neuropathy and autonomic dysfunction. The musculoskeletal is also affected by T2DM and causes pain, dysfunctions, and disabilities. Thus, this study is to find the prevalence of neuro-musculoskeletal complications in patients with T2DM. This cross sectional survey was conducted in various public and private sector hospitals of four major cities of Pakistan (Islamabad, Karachi, Lahore, and Sargodha) from 1<sup>st</sup> May to 31<sup>st</sup> December 2015. The patients of type II diabetes mellitus with both gender and age above 40 were included, and patients with active systemic disease of bones and soft tissues were excluded. A self-structured questionnaire was developed, reviewed by experts, and finalized after calculating their recommendations. The questionnaire was distributed among 600 patients, out of whom 500 patients responded. The non-probability convenient sampling technique was used for data collection. The data was analyzed by SPSS and percentages were calculated to estimate the neuro-musculoskeletal complications in patients with T2DM. The prevalence of neuro-musculoskeletal complication in type II Diabetes mellitus was 100 %, while the frozen shoulder, tingling sensations and ants crawling sensations (61%) were equally the most common neuro-musculoskeletal complications followed by knee pain (53%), low back pain (43%). The most involved age group was 61 to 65 years and 58% patients were with positive family history. The most commonly used way of treatment was medications (90%) and physical therapy (10%). It was proved in study that frozen shoulder, altered sensations, knee pain and back pain have high association with long duration of T2DM. There is association between long duration of diabetes mellitus and neuro-musculoskeletal complications. It is concluded that the prevalence of neuro-musculoskeletal complications is high among patients of T2DM and commonly affects shoulder, back, knee and altered sensation in legs. These are most commonly managed with medications followed by physical therapy.

**Keywords:** T2DM, neuro-musculoskeletal, complications, frozen shoulder, Range of motion

## 1. Introduction

Diabetes mellitus (DM) is a metabolic disease characterized by hyperglycemia. DM patients have a lifelong or long-term disorder of high blood glucose level. High blood glucose level with disturbances of carbohydrate, fat, and protein metabolism causes defects in insulin secretion, insulin action, or both. . In 2013 it was statistically concluded that 382 million people with DM all over the world have high prevalence of T2DM .It is suspected that 592 million people will die of DM in 2035 (Tao, Shi, & Zhao, 2015).

DM genetically and hereditary belongs to heterogeneous group of disorders (Hussain, Hussain & Hussain, 2015). Endoplasmic reticulum is the main organ of body which control cellular hemostasis but due to some environmental factors ER function is depressed and causes pancreatic B cell destruction in T1DM and pancreatic B cell failure in T2DM. The pancreas does not make a hormone called insulin which help to regulate the glycaemia level in human body (Engin, 2016).

Diabetes is the seventh most leading cause of death in the United States. It is a chronic and constant disease which poses a major threat to human population. DM greatly affects young population particularly in developing countries due to poor socioeconomic status, education, and lack of awareness. Currently, Around 180 million people are affected by diabetes and according to researchers, by 2015 it will multiplied (American Diabetes Association, 2013).

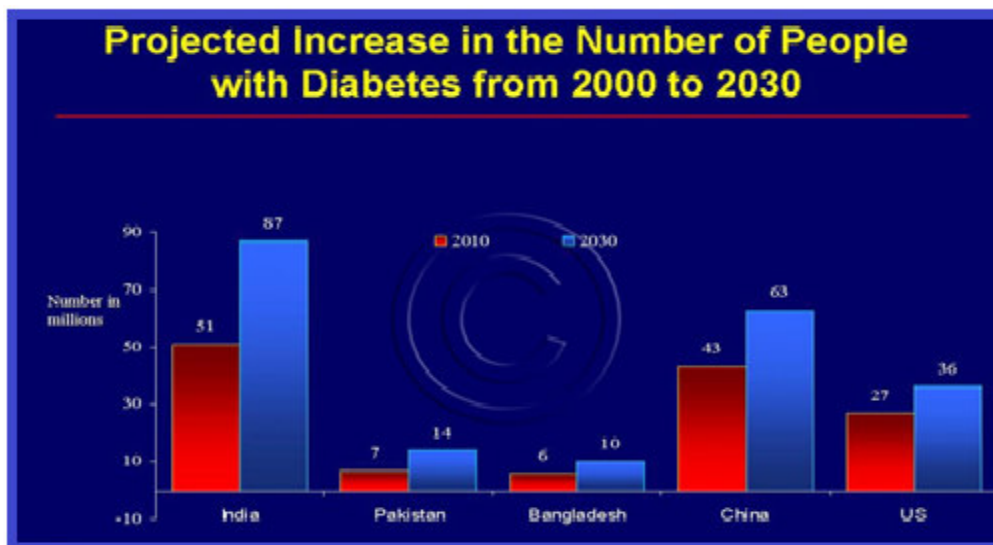


Figure 1: Projection graph in five countries reflecting increase of Diabetes

Prevalence of diabetes in India, Pakistan, Bangladesh, China and US by 2030 (Ansari, Dixon, & Coles, 2015). Pakistan stands on 7<sup>th</sup> in the prevalence list with 7 million DM patients.

Type 1 DM is an Insulin dependent DM and is also known as Juvenile DM. It has an abrupt onset of clinical symptoms. The patient of type 1 DM depends upon insulin. It is affected by genetic and environmental factors. Genetically onset of type 1 DM is affected by the increase and decrease of histocompatibility antigen (HLA) on chromosome 6 (Nerup et al., 1976). Environmental factors may affect people directly by B cell toxicity and by stimulating the autoimmune reactions against the B cell. Type 1 DM is also affected by different viruses(mumps, retroviruses), chemical substances and dietary components(mumps, retroviruses) (Purohit, Sharma, & She, 2015). T1DM patients have progressive B cell destructions, which cross a certain threshold level at which adequate insulin secretion level cannot maintain for a longer period and increase the rate of mortality in T1DM (Snell-Bergeon, & Maahs, 2015).

Type II DM is also known as noninsulin- dependent diabetes mellitus. It is one of the chronic health problems all over the world. Type II DM is a cause of death and disability due to their chronic complications. It is evaluated that that by 2030 adults suffering from T2DM may rise to 439 million (Liu et al., 2010). Patients of this type of diabetes do not require insulin to sustain their life, in order they require insulin for the prevention of ketoacidosis and symptoms which cannot be achieved by the diet and drugs. Patients having non-insulin dependent diabetes may be asymptomatic or may exhibit slow progression of clinical symptoms.

T2DM is a hereditary disease which causes life time neuro-musculoskeletal complications. It requires treatment and self-management. Family history and obesity is usually a positive factor in T2DM (Cederberg, et al., 2015). T2DM mostly occurs after the age of 40 but in rare cases it may affects young population. Genetically it is autosomal dominant inheritance. T2DM is mostly present in obese patients (National Diabetes Data Group, 1979).

Reduction in the total mass of pancreatic islet is a hallmark of T2DM. Brain derived neurotrophic factor (BDNF) is associated with the development of T2DM. If serum BDNF is low, it causes obesity and impaired glucose metabolism (Li, Lang, & Cheng, 2015). Recent researchers conclude that low socio-economic status, aggressive behavior, mental health problems and social disparities causes T2DM (Kelly & Ismail, 2015). People who have impaired fasting glucose are at a highest risk for non-insulin dependent diabetes (Rimm, et al., 1995).

Table 1: Contrasting Types 1 DM and Type II DM

	Type 1 DM	Type II DM
onset of age	<40	>40
Duration of symptoms	Weeks	Months or years
Body weight	Low or normal	Obese
Ketonuria	Yes	No
Prevalence of death	Yes	No
Autoantibodies	Positive	Negative
Diabetic complications	No	Yes
Family history	No	Yes
Other disease prevalence	Common	Uncommon

DM is a chronic condition. The growth rate of people with diabetes is increasing day by day due to unhealthy life style, uprising population, obesity, and depression and ultimately requires management (Semenkovich et al., 2015). Diet and exercise plans are helpful in the prevention of cardiovascular problems associated with diabetes (Balk et al., 2015). Nowadays Glucagon-like peptide-1 (GLP-1) analog liraglutide is used for DM treatment because with anti-diabetic medicine it maintain the glycaemia level very efficiently and are safe and tolerable (Petri, Jacobsen, & Klein, 2015). When conventional therapy diet, exercise and weight loss does not produce significant effect in controlling glucose level then aggressive weight loss treatment plan is used and oral anti diabetic drugs are used (Scheen, 2015).

This disease occur due to hyperglycemia that causes long term organs dysfunction , blindness, neuropathy with the risk of foot ulcers which leads to amputation, Charcot joints, and features of autonomic dysfunction including sexual dysfunction. People with diabetes are at increased risk of cardiovascular problems, kidney failure, peripheral vascular and cerebrovascular disease (Gautam, 2014). Complications commonly occur in T2DM patients are as following:

#### *1.1 Diabetic polyneuropathy (DPN)*

Diabetic polyneuropathy is a common complication of DM. In this, patient suffer with muscle weakness, muscles atrophy, less contractile property of muscle but increase antagonist muscle contraction and many neurological problems. It is mostly caused by alpha motor neuron dysfunction and changes in muscle fibers. Muscles strength is loss, planter flexion and dorsiflexion power is reduced in DPN. Smoking, abnormal glucose control, females, long duration of DM and retinopathy are the risk factors of DPN. Normal muscle mass and contractile property of muscle is reduced (Moore, 2015).

#### *1.2 Frozen shoulder*

Frozen shoulder is the most common complication of diabetes. Frozen shoulder is dependent upon patient age and duration of DM. In frozen shoulder, both active and passive range of motion is limited. It is classified as (i) primary, in which etiology of restricted range of motion is not known and (ii) Secondary, in which etiology is known. Main causes of frozen shoulder are (i) Intrinsic causes mean ROM is restricted due to any rotator cuff muscle. (ii) Extrinsic causes include any surgery of chest wall, cervical radiculopathy. (iii) Systemic causes include any systemic disease like DM. In frozen shoulder all ROM is restricted but extension and external rotation movement is more affected. Patient also feels pain in all movements of shoulder. Daily life routine of patient is disturbed; he is not able to do his routine works. According to previous studies frozen shoulder have high prevalence in diabetic patients (Angelo, et al., 2015).

Frozen shoulder patient has limited range of motion and face problems in the completion of their routine works. With the passage of time many advance treatments are developed for the management of frozen shoulder. Suprascapular nerve block is used for the pain reduction and restore of active range of motion (Mortada, 2015). Frozen shoulder is treated affectively with pregabalin, glucocorticoid therapy and physiotherapy exercise plan (Canbulat, 2015).

#### *1.3 Back pain*

Low back pain has a high prevalence in diabetic patients which is increasing day by day and current researches also prove it. According to study, back pain has high prevalence in diabetic patients than non-diabetic patients which is found to be 46.2% (Idowu, 2015).

#### *1.4 Knee pain*

Diabetes is caused by obesity and obesity is the risk factor for the development of osteoarthritis which is the leading cause of knee pain in DM patients. Studies prove that diabetes reduces the joint space in knees which causes pain (Eymard, 2015).

### **Literature review**

Around the globe type 2 DM is found to be a major chronic disease (Cadliero, 2002). It was estimated in 2011 that 14 million people were suffering from DM in Africa and will increase by double in 2030 (Burner, 2009). In addition type 2 DM is more commonly seen in urban areas in contrast to rural areas (Grey A. Delbeth 2003). The principle risk factor that exacerbates type 2 DM among population is thought to be physical activities, diet and aging. High-calories fatty diet with minimum or no physical activity is a major cause of obesity (Smith, 2003). In addition, obesity impedes glucose tolerance leading to increase chance of diabetic manifestation (Kapoor, 2003).

To reduce the complication of type 2 DM, sustain glycaemia level should be ensured (Andersom, 2007). According to UK Prospective diabetes study (UKPDS) 1% reduction was seen in glycaeted HbA1c which was associated with 37% decrease in neural and 14% decrease in muscular complication (Kapoor, 2003). As

evaluated from 10 years follow-up study, individuals (with type 2 DM) that maintain their glycaemia level experience benefit many years later that includes reduce chances of neuromuscular complication and diabetes-related death (Makita 1991). The etiology of neuromuscular complication is not clearly understood (Burner 2009). Individuals with poor glycaemia control are associated with increase prevalence of neuromuscular complication (Cadliero, 2002). These neuromuscular complications are widespread and are common cause of sickness (Makita, 1991).

T2DM is a hereditary disease which causes life time neuro-musculoskeletal complications. It requires treatment and self-management. Family history and obesity is usually a positive factor in T2DM (Cederberg, et al., 2015). T2DM mostly occurs after the age of 40 but in rare cases it may affects young population. Genetically it is autosomal dominant inheritance. T2DM is mostly present in obese patients (National Diabetes Data Group, 1979).

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## **2. Materials and methods**

### *2.1 Study design:*

Cross sectional survey because the study is an attempt to investigate within six months timeframe (Zehra, et al., 2017).

### *2.2 Setting*

The study was conducted in public and private hospitals of four major cities (Lahore, Karachi, Islamabad, and Sargodha) of Pakistan.

### *2.3 Duration of study*

The duration of the study was from 1<sup>st</sup> May to 31<sup>st</sup> December 2015.

### *2.4 Sample size and sampling technique*

Total 500 patients were included in the study. The Non probability convenient sampling technique was used to collect data.

### *2.5 Sample selection*

#### *2.5.1 Inclusion criteria*

Type II DM patients

Having age above than 40

Both genders male and females

### 2.5.2 Exclusion criteria:

- Type I DM patients
- Age below 40
- History of trauma
- Patient having DM but complication develop after fracture
- Dislocations
- Malignancy
- Autoimmune disease
- Other systemic problems
- Prior history of any neuromuscular condition

All the patients who have T2DM with the positive family history were included in the study. The patients who have another systemic disease, fracture, trauma etc were excluded. The demographic data i.e. age, gender, sugar level were noted. This helps in data reliability, credibility, and validity (Haque & Yamoah, 2014; Haque & Aston, 2016). Data was collected from private and public hospitals of four major cities of Pakistan (Islamabad, Sargodha, Karachi, and Lahore). The data were collected after taking the consent from the patients.

A self-structured pre-tested questioner was used to collect the data. It was a non-probability convenient sampling study to find out the prevalence of neuro-musculoskeletal complications in T2DM. Questionnaires were distributed among 600 patients in whom 500 patients responded. 51.4% females and 48.6% males participated in the study. Patients having age above 45 years were included. Age group 61-65 years with history of DM for more than 3 years was more affected and show high prevalence for neuro-musculoskeletal complications. Data was analyzed on SPSS version and percentages were calculated to estimate the neuromuscular skeletal complications in patients with T2DM.

### 3. Results

The prevalence of neuro-musculoskeletal complication in type II Diabetes mellitus was 100 %, while the frozen shoulder, tingling sensations and ants crawling sensations (61%) were equally the most common neuro-musculoskeletal complications, followed by knee pain (53%), low back pain (43%). These complications have high associations with long duration of T2DM. The most involved age group was 61 to 65 years and 58% patients were with positive family history. The most commonly used way of treatment was medications (90%) and physical therapy (10%). It was proved in study that frozen shoulder, altered sensations, knee pain, and back pain have high association with long duration of T2DM.

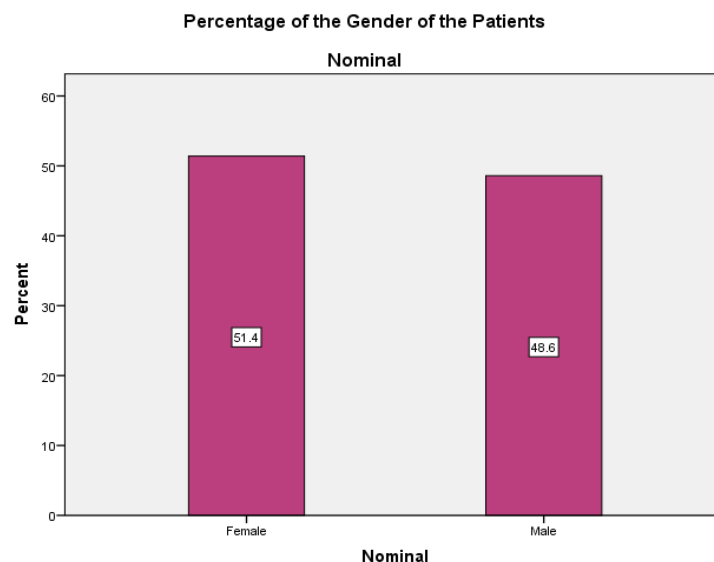


Figure 2: Percentage of the Gender of the Patients Nominal  
The above graph shows that 51.4% Females and 48.6% Males participated in the study.

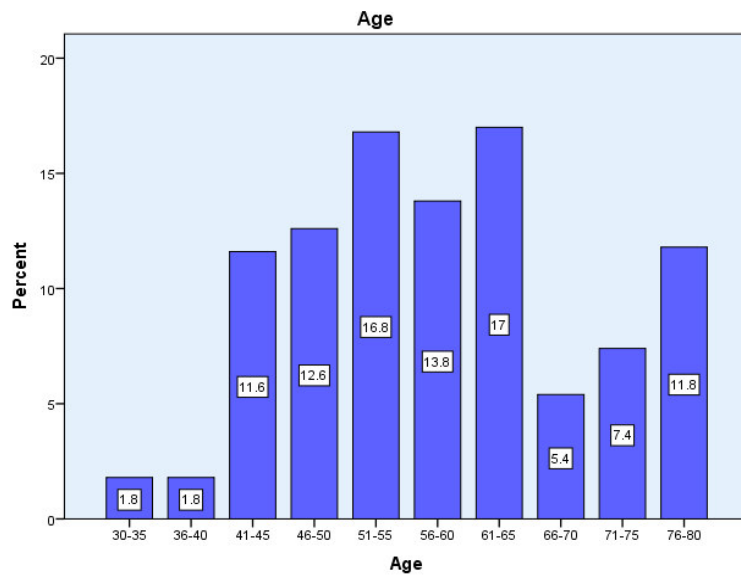


Figure 3: Age of participants

The above graph shows that the % of the patients with the age group of 30-35 years are 1.8%, 36-40 years are 1.8%, 41-45 years are 11.6%, 46-50 years are 12.6%, 51-55 years are 16.8%, 56-60 years are 13.8%, 61-65 years are 17.0%, 66-70 years are 5.4%, 71-75 years are 7.4% and 76-80 years are 11.8%.

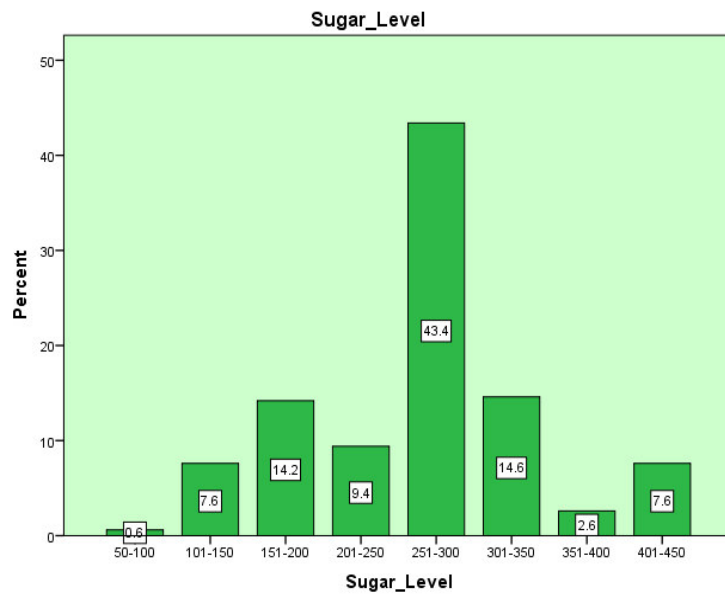


Figure 4: Participants' sugar level

The graph shows that the % of patients having sugar level group of 50-100 are 0.6%, 101-150 are 7.6%, 151-200 are 14.2%, 201-250 are 9.4%, 251-300 are 43.4, 301-350 are 14.6, 351-400 are 2.6 and sugar level group of 401-450 are 7.6%.

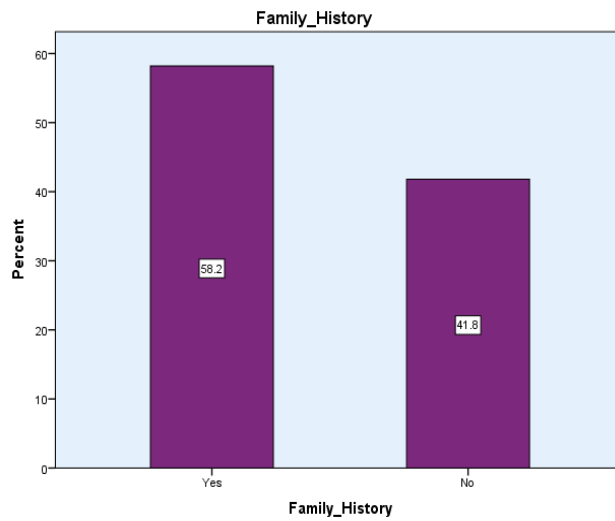


Figure 5: Family history of participants

The graph shows that 58.2% people have family history of diabetes while 41.8% shows no positive family history.

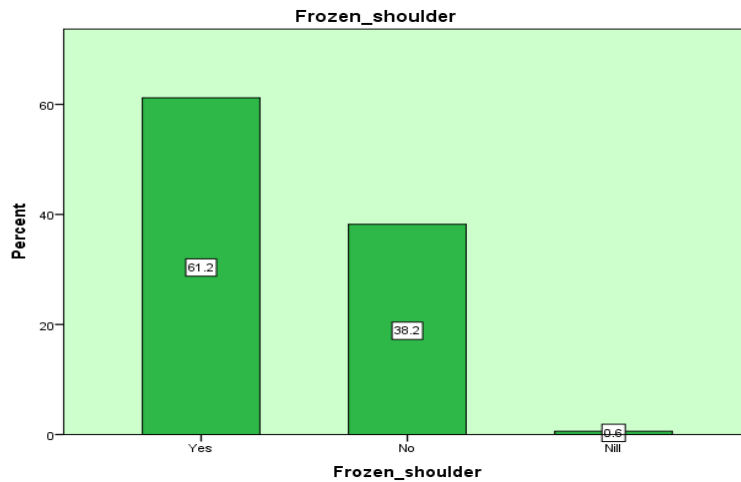


Figure 6: Frozen shoulder percentages

The above graph shows that 61.2% patients say that they have frozen shoulder while 38.2% says they do not have frozen shoulder. 0.6% patients do not respond to this question.

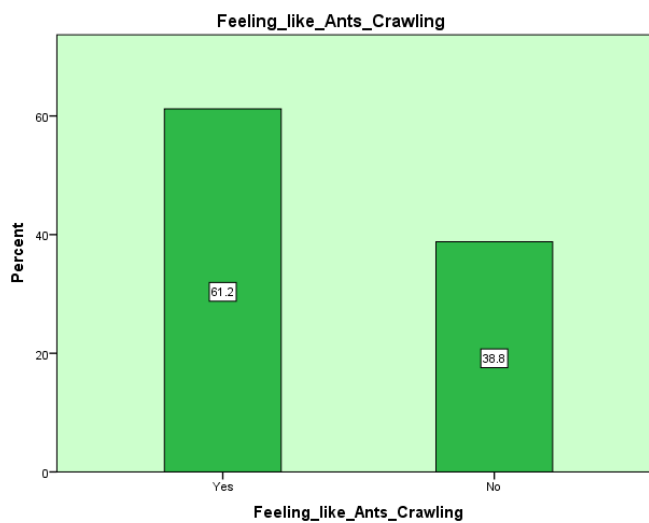


Figure 7: Percentages of feeling like ant crawling

The graph shows that 61.2% patients feel ants crawling sensations while 38.8% don't feel.

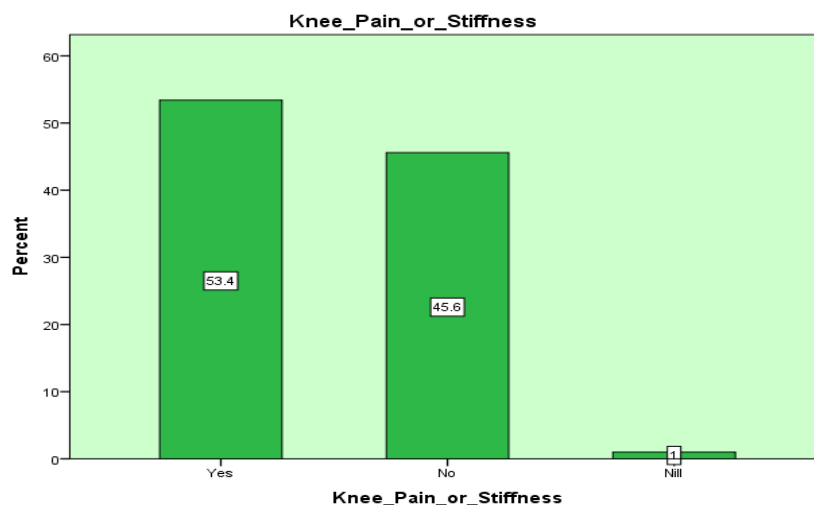


Figure 8: Percentage of Knee Pain or Stiffness

The above graph shows that 53.4% patients feel pain or stiffness in knee while 45.6% don't feel pain. 1.0% don't respond to this question.

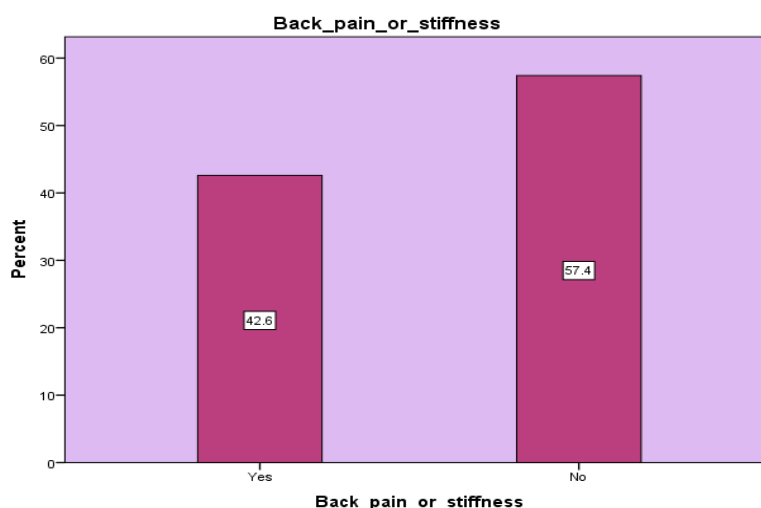


Figure 9: Percentage of Back pain or Stiffness

Graph shows that 42.6% people say that they feel stiffness and back pain while 57.4% says that they don't feel stiffness and back pain.

These complications have association with long duration of T2DM.

#### 4. Discussion

The aim of the current study was to investigate the prevalence of common neuro-musculoskeletal complications in T2DM. The total participants were 500. The result shows high prevalence of neuro-muscular skeletal complications in T2DM patients. Mostly patients have positive family history of diabetes. Age groups of 61-65 years were affected mostly having sugar level 251-300 and have T2DM more than 3 years ago. Moreover, 90% patients use allopathic medicines but mostly patients have fluctuations in blood pressure besides the use of medicines. The prevalence of neuro-musculoskeletal complication in type II Diabetes mellitus was 100%, while the frozen shoulder, tingling sensations and ants crawling sensations (61%) were equally the most common neuro-musculoskeletal complications, and followed by knee pain (53%), low back pain (43%). Long-term duration of T2DM shows high prevalence with frozen shoulder, altered sensations, knee pain and back pain.

Long duration T2DM develop peripheral neuropathy. It causes alternate sensations especially in lower limbs which causes foot ulcer and lead to amputations. Recent studies showed that neuropathic changes occur in the early stage of diabetes. Age, long duration of diabetes and abnormal glucose level are the main risk factors for the development of peripheral neuropathy. In a previous study it shows that patient have DM <5 year shows



20.8% prevalence which increases to 36.8% prevalence with duration >10 years (Lee, 2015). Current study also proves that peripheral neuropathy prevalence is high with long duration of diabetes, which is 61%.

T2DM rate is increasing day by day due to sedentary life style, lack of awareness of self-management and inadequate nutrition. It showed that neuropathy had high prevalence in neuro-musculoskeletal complications (Sosale et al., 2016). Current study also shows that neuropathy have high prevalence which is 61%.

Another study says that T2DM patients have high prevalence of neuropathy which is 13.2% which is followed by retinopathy 5.1% and nephropathy which is 0.9% smoking, hyperglycemia are risk factors for the development of neuropathy complications (Plancher & Petterson, 2016). Current study also proves that neuropathy have high prevalence which is 61 %.

Frozen shoulder is normally present in population but its incidence rate is increased to 10 -15% in diabetic population. It is a common musculoskeletal complication of DM patients. Many previous studies prove its high prevalence in diabetes. According to one study frozen shoulder has high prevalence in diabetic, female gender age above than 40 (Angelo et al., 2016). Current study highlights that frozen shoulder have highest prevalence (61%) with female gender and age between 61-65 years.

Frozen shoulder in T2DM patients have a prevalence of 22.4% which is higher than T1DM patients which is 10.3% (Fatemi et al., 2015). Current study shows the same results that T2DM patients have high prevalence of frozen shoulder.

Another study shows that 88 patients of frozen shoulder have no previous known positive history of diabetes but blood sample proves that they have diabetes and show prevalence of 38.6% which is higher than non-diabetic frozen shoulder patients (Shah et al., 2015). Interestingly, patients has affected from occupational stress that deteriorate their health (Haque et al., 2016).

Different studies prove that diabetic patients are mostly older age and they have at least one co-morbid. One study shows that knee osteoarthritis and shoulder complication have high prevalence in diabetic patients than non-diabetic patients (Pai et al., 2015). Present study shows that shoulder and knee complications have high prevalence which is 61% and 53% respectively.

A research shows that diabetic patients have impaired sensations, limited range of motion of shoulder and hands less pinch grip of hand as compared to the non-diabetic patients. Present study shows that 63% patients have shoulder pain and limited joint range of motion (Pai et al., 2015). Recent study also shows that frozen shoulder and altered sensation have high prevalence in diabetic patients.

T2DM patients have sedentary life style; they are mostly inactive and obese and have many complaints of musculoskeletal pains. According to one study T2DM patients have higher mean visits to doctor for muscular pain than non-diabetic patients (Eymard, et al., 2015). Current study proves that T2DM patients have more frozen shoulder 61%, knee pain 53% and back pain 43 %.

T2DM causes less joint space in knee. Due to less joint space patients feel pain. A previous study shows that T2DM causes less joint space in knee joint of obese DM patients than non-diabetic patients which is (0.26 [-0.35 to -0.17] vs 0.14 [-0.16 to -0.12] mm;  $P = 0.001$ ) (Idowu, et al., 2015). Current study shows that T2DM patients are more affected with knee joint pain which have 53% prevalence.

T2DM patients are more affected with chronic low back pain. Previous studies proves that DM have a high prevalence of low back pain than non-diabetic patients which is 41.3% (Yurdakul, et al., 2015). Present study shows high prevalence of back pain which is 43%.

T2DM have a high prevalence of neuropathy complications. Previous studies prove that it causes altered sensations in hands like carpal tunnel syndrome. Perkins et al reported that CTS is common in 30% diabetic neuropathy (Alonso-Morán, 2015). Current study shows that diabetic neuropathy have a high prevalence which is 61%.

T2DM patients have many complications at a time. There isn't any single person in this world that has no complication after the development of diabetes. According to study 92% females have multi morbidity due to T2DM (Baba et al., 2015). Present study shows 100% prevalence of complications in T2DM patients.

A study show high prevalence for foot ulcer and diabetic foot. Long duration of diabetes and polyneuropathy cause high prevalence of foot ulcer (Magnusson et al., 2015). Current study show only 40% prevalence of foot ulcer and diabetic foot which is less than frozen shoulder prevalence.

A previous study shows that diabetic patients, female gender, age above than 45 have hand pain due to Diabetes (Ranger et al., 2015). Current study show less prevalence of wrist and finger pain in T2DM which is 18% and 13% respectively.

Previous studies shows high prevalence or association of diabetes and elbow pain and tendinopathy (Ranger et al., 2015). Current study show only 16% prevalence of elbow pain.

## 5. Conclusion & Recommendations

It is concluded that the prevalence of neuro-musculoskeletal complications is high among patients of T2DM and commonly affects shoulder, back, knee and altered sensation in legs. These are most commonly managed with

medications and followed by physical therapy. In addition to that, the stress among patient is one of the contribution factor enhancing different types of pain and anxiety. It is recommended to conduct further studies on the topic with large sample size across the country to further investigate the prevalence of neuro-musculoskeletal complications.

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