

Original Article

Epidemiological Prevalence of Frozen Shoulder in Patient.**Maida Ali¹, MemonaAli², SamreenRiaz^{3*}**¹⁻²*Teaching Hospital Lahore. Pakistan.*³*Institute of Microbiology and Molecular Genetics, University of the Punjab, Lahore. Pakistan.***Abstract:**

Introduction: This study's goal is to determine the connection between the patients of frozen shoulder and diabetes. The study was done on past ten-year data of the patients visiting to tertiary teaching care centre of Lahore.

Methodology: The data was categorized into four groups; patients with frozen shoulder, patients with diabetes, patient having diabetes with frozen shoulder, and healthy. Different parameters (age, gender, history of diabetes, history of frozen shoulder, range of motion, history of trauma and associated pain) related to frozen shoulder were observed. In statistical analysis, graphs are plotted by using Microsoft Excel and SPSS v 20.

Results: The commonly encountered Mucoskeletal disorder is frozen shoulder or adhesive capsulitis in physiotherapy unit. It affects approximately 2-5% of general with the predominance of female in ratio of 58:42 with males.

Conclusion: It is evaluated that the group in which patients have diabetes and frozen shoulder has higher prevalence than all other groups.

Key Words: Frozen shoulders, diabetes, Pakistan.

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Introduction:

Frozen shoulder is self-limiting but pain and disability can last up to many years if it is unchecked. It is thought it is caused by synovial inflammation and capsular fibrosis. The commonly encountered Mucoskeletal disorder is frozen shoulder or adhesive capsulitis in physiotherapy unit. It affects approximately 2-5% of general with the predominance of female in ratio of 58:42 with males. Between 30 and 70 years old, on average of 50, is when symptoms first appear. It begins with spontaneous pain with the active and passive degeneration of the glenohumeral joint motion which ultimately leads to the loss of motion of shoulder. This condition can attack contralateral side of shoulder after many years of first onset of pain. It does not affect same shoulder again.

The risk of developing frozen shoulder is increased by trauma or surgery, hormonal disease (disease related to thyroid, diabetes, adrenocorticotrophic hormonedeficiency), neurologic and cardiac disease (stroke and Parkinson' disease), certain medication ,malignancies, hyperlipidemia, neurosurgery, (protease inhibitors, influenza, antiretrovirals, pneumococcal vaccine and metalloproteinase inhibitor, fluoroquinolones and Contracture of Dupuytren.Dysfunction of the shoulder is due to the formation of excessive glenohumeral joint adhesion or scar tissue. Activities of everyday living are halted by shoulder stiffness. Primary or secondary adhesive capsulitis are also possible. Without any external trauma, primary adhesive capsulitis develops spontaneously.On the other hand trauma and fracture resulting dislocation of glenohumeral joint cause secondary adhesive capsulitis.

It may be primary and connected with the systemic illness or no exogenous cause. It can have a secondary cause, however diabetes is usually connected. According to reports, people with diabetes have a 10–36% probability of

developing frozen shoulder, and this risk is constant for both types of diabetes. Patients having frozen shoulder with diabetes are in severe condition and usually resistant to treatment and incidence of such cases reported to be 10-36%

It has a connection to hand Dupuytren's disease, in which a fibromatosis appear due to contracting shoulder tissue, hypoadrenalism and hyperthyroidism in addition other conditions associated are pulmonary disease, Parkinson's disease, Stroke, thyroid disease, adrenal disease cardiac disease, and cardiopulmonary disease. Muscle spasticity in shoulder region cause stiffness in case of stroke.

Frozen shoulder occurs in three phases: freezing, frozen and thawing. Freezing is characterized by the pain of shoulder that leads to loss of motion gradually. Frozen stage is active or passive range of motion causing stiffness. Thawing is recovery stage in which motion of shoulder is improved and symptoms are resolved. Secondary FS can be classified as either non-traumatic (such as rotator cuff tendinopathy and osteoarthritis) or traumatic (such as fracture, dislocation, and soft tissue damage). The coracohumeral and middle glenohumeral ligaments appear inflammatory, especially around the rotator interval, and there is thickening and congestion of the capsule, according to macroscopic observations. Large number of mast cell, fibroblast, macrophages and T cell has been observed on affected capsule. In a study, at the mean of 7 year of onset of condition 50% of patient were still having pain and stiffness and 11% show limitation functionally.

Diabetes mellitus has been underestimated as a threat for health worldwide and become most important challenges for the latest century. It took time to understand it as there is lack of accurate data for monitoring. The attempt to obtain the correct data in the past are not explained well and needs remain unsatisfied. International efforts trying to collect all the

information of DM but run short of the requirements. This underrate the disease burden because the estimates are inaccurate and providing a rough idea. Currently used procedures are not sufficient to find the chance of occurrence of diabetes mellitus completely and precisely. The collection of national statistics on diabetes mellitus and its prevalence must adhere to international norms and guidelines.

High blood glucose levels (hyperglycemia), insufficient insulin secretion, ineffective insulin action, or all are indications of diabetes mellitus. It imbalances the metabolism of the patient that lead to the micro and macro vascular complications. If such complications remain unchecked or untreated they may lead to serious problems that include the higher risk of developing heart diseases (cardiovascular diseases). Any one of the four plasma glucose (PG) criteria can be used to determine diabetes:

1. FPG (fasting plasma glucose) > 126 mg/dL
2. A 75g oral glucose tolerance test (OGTT) with 2 hours of PG (>200 mg/dL)
3. Random PG (>200 mg/dL) with signs of high blood glucose
4. Hemoglobin A1C level >6.5%

There is no preference of one test over another for the diagnosis according to the American Diabetes Association (ADA). It is recommended that adults with the age of 45 years must undergo these tests in spite of their body weight and the adults which do not have any symptoms but are obese must test themselves for this because they have extra risk factor of developing diabetes.

LITERATURE REVIEW

Adhesive Capsulitis

Adhesive capsulitis is a self-limiting disorder with a traumatic history of progressive discomfort in the glenohumeral joint and movement restriction. External rotation is

restricted due to capsular pattern of joint that leads to abduction in plane of scapula and then flexion. Codeman in 1934 described Diagnostic method in comparison with normal radiograph showing the limitation of flexion and external rotation due to primary onset and painful restriction of glenohumeral movement. 3,586 sources were consulted between 1966 and 2008 when the term "frozen shoulder" was searched for on Medline search of National Library of Medicine Citation.

It limits the shoulder movement from completely too varying degree.

Stages of AC

Laudberg divided Frozen shoulder into primary (non-traumatic) and secondary (traumatic).

While Reeves divide it into threestages viz.

- Stage of Pain (10-36 weeks)
- Stage of stiffness (4-12 months)
- Stage of recovery (5 months- 2 years)

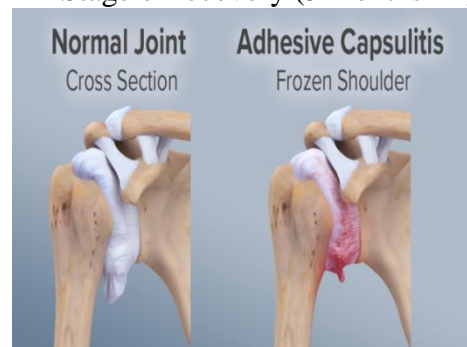


Fig. 1: Normal joints and Adhesive capsulitis

Classification of FS

Joseph et al develop an introductory definition and classification of FS. In further literature review, it is found that definition and subtypes of FS are absent which make this condition problematic in either diagnosis or treatment modalities.

Zuckerman classify primary and idiopathic AC in same category as both are not related to any

trauma or systemic illness while subtypes for secondary FS were defined like systemic, extrinsic and intrinsic. The degree of shoulder stiffness and range of motion are used to grade irritability. Primary and secondary FS characterized by the consistent pain and loss of motion of shoulder with passage of time. Patient usually seeks medical help when they have pain at night

Stage 1 The preadhesive stage	Stage 2 The acute adhesive or "freezing" stage	Stage 3 The fibrotic or "frozen" stage	Stage 4 The "thawing" phase
Hyper vascular synovitis with normal underlying capsule.	Decrease in hyper vascular synovitis with early adhesion formation leading to capsular contraction and thickening.	Less synovitis but more mature adhesion in the capsule and axillary fold.	Severe capsular restriction without apparent synovitis.
Patients present with mild or no end-range limitation and pain.	Patients have a high level of discomfort, limited passive and active motion, and increased pain near end-range of motion.	Patients note significant motion limitation with minimal pain.	Patients in this phase present with painless restriction of motion, which typically improves by remodeling.
Treatment Goal - decrease pain by interrupting the cycle of inflammation and pain	Treatment Goal - restore the normal glenohumeral biomechanics in addition to decreasing inflammation and pain.	Treatment goal - aggressively treat significant loss of motion and restore normal range of motion and functionality of the shoulder joint.	Treatment goal - maintain the normal range of motion and shoulder function while maintaining the normal glenohumeral biomechanics and avoiding pain and inflammation.
May last between 0-3 months.	May last between 3-9 months.	May last between 9-15 months.	May last between 15-24 months.

Table 1: Stages of frozen shoulder

Three categories are further broken up into this.

1. Intrinsic:

This segment covers restrictions in both passive and active range of motion that are brought on by rotator cuff disorders (partial- or full-thickness tears and tendonitis), calcific tendonitis or biceps tendonitis (calcific deposits within the subacromial space/rotator cuff tendons would be an acceptable radiographic finding in the case of calcific tendonitis).

2. Extrinsic:

This category includes cases where there is a connection to an identified abnormality that is not directly related to the shoulder. Examples include restrictions in active and passive motion related to prior ipsilateral breast surgery, cervical radiculopathy, chest wall tumors, prior cerebrovascular accidents, or more local extrinsic issues such as prior humeral shaft fracture,

scapulothoracic abnormalities, acromioclavicular arthritis, or clavicle fracture.

3. Systemic:

These situations involve systemic illnesses, but not limited to diabetes mellitus, hyperthyroidism, hypothyroidism, hypoadrenalism, or any other condition that has been documented to have an association with development of frozen shoulder.

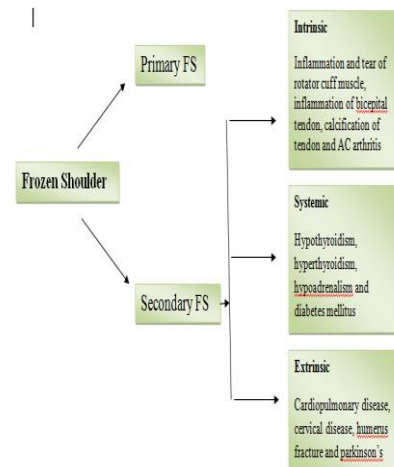


Fig 2: Frozen Shoulder points

Risk factor of AC

Risk factors along with this condition are previous trauma, increasing age, female gender, dyslipidemia, hypertension, thyroid dysfunction and diabetes mellitus. Sung et al., 2014 showed that primary AC is significantly connected with hypercholesterolemia and inflammatory lipoproteinaemias, although it is impossible to show their cause and effect relationship. The chance of occurrence of AC in population is 2% but the real prevalence is approximately 0.75%, it also varies within the patients of diabetes mellitus. Chances of having AC in DM or DM in AC should be clear to physician or surgeon for management of such conditions and guide

studies in adding patients of DM with this condition to reduce risk of partiality and giving insights of pathogenesis for the results of AC patients.

When Moren-Hybbinette et al. examined the normal course of the painful, stiff shoulder associated with diabetes, they discovered that 35 (65%) out of 54 shoulders had a reduced range of motion after an average follow-up of 29 months. Zriek et al reviewed published articles to check prevalence of AC in DM, DM in AC and either the rates are influenced by DM type and treatment or not.

Risk factorsHLA-B27 positive and protracted immobilisation of the glenohumeral joint are risk factors for adhesive capsulitis. According to estimates, women make up 70% of patients with sticky shoulder capsulitis. Men also don't react to therapies as well as women do. According to demographic research, people with adhesive capsulitis tend to be between the ages of 40 and 59 (84.4%).Charalambous, adhesive capsulitis may have a genetic tendency. This ailment is more likely to affect white individuals, patients with a favorable family history, and patients who have the HLA-B27 gene. Diabetes, thyroid illness, cerebrovascular disease, coronary artery disease, autoimmune disease, and Dupuytren's disease are all linked to adhesive capsulitisBoth type I and type II diabetes people are more likely to develop adhesive capsulitis, with prevalence rates of 10.3% and 22.4%, respectively, according to study including 318 patients. In comparison to non-diabetic patients, adhesive capsulitis patients with diabetes experience lower functional outcomes.Compared to the general population, patients with hyperthyroidism have a 1.22 times higher chance of developing adhesive capsulitis, according to a nationwide population-based study performed by Huang et al. In one prospective study of this high risk cohort, 23 of 91 patients (25.3%) who had cerebrovascular disease—particularly those who had undergone

surgical treatment for subarachnoid hemorrhage—developed sticky shoulder capsulitis within six months. Dupuytren's disease was discovered in 52% of patients (30 of 58) with adhesive capsulitis, according to research by Smith et al. Although patients with the aforementioned linked illnesses have a higher prevalence of adhesive capsulitis, more research is required to understand the reasons behind these associations.

Incidence:

Women have higher risk of AC with the passage of age than males. It ceases the life of patients and decreases the quality of life as it lasts up to variable time period usually 1-3 years.

Between 3 and 5% of patients with diabetes will develop FS, which has a tendency to cause more severe symptoms and treatment resistance. It can occur bilaterally and most frequently affects people in their middle years, significantly more so in women than in males. Frozen shoulder can develop as a result of trauma and is linked to Peyronie's disease, Dupuytren's contracture, and other connective tissue diseases. Diabetes is a predictor for this postoperative complication, which has been observed in up to 11% of individuals having arthroscopy.

PREDISPOSING FACTORS

A period of shoulder immobilisation is typical of the majority of frozen shoulder syndrome patients. Although the causes of the immobilisation can vary, all of these individuals have a time of limited shoulder motion. Bruckner et al. found that the incidence of frozen shoulder was between 5 and 9 times higher in patients with neurosurgery who had their shoulders immobilised for varied lengths of time. Another characteristic of frozen shoulder syndrome is that it typically affects people between the ages of 40 and 70.

Several other illnesses have also been linked to frozen shoulder. Compared to the general population (2%–5%), diabetics have a higher incidence of frozen shoulder (10%–20%). The incidence is even higher (36%) among diabetics who are insulin dependent, and bilateral shoulder involvement occurs more frequently. Therefore, it is essential to screen for diabetes in any new patient who presents with suspected frozen shoulder syndrome. Patients with cervical spondylosis, ischemic heart disease, and hyperthyroidism have all been linked to frozen shoulder. The doctor treating patients with frozen shoulders needs to be aware of the connections between these illnesses and frozen shoulder. With this knowledge, he is then able to warn "at-risk" patients who are receiving care for other ailments of their greater chance of acquiring a frozen shoulder.

Burden of peri arthritis:

Diabetics have higher rates of occurrence and prevalence of musculoskeletal problems. Adhesive capsulitis was more common in the type II diabetic population (71.5%) with poor glycemic control and a HbA1C of 9%. Despite the clinical importance of the presenting disease, 51.9% of patients disclosed rejecting testing positive for pre-diabetes or diabetic mellitus according to American Diabetic Association (ADA) guidelines. Adhesive capsulitis may be a sign of undetected diabetes in 38.6% or pre-diabetes in 32.95% of cases.

According to estimates, 11-30% of diabetic patients and 2-10% of non-diabetics have periartritic shoulders. Age and the length of the diabetes disease are associated with adhesive capsulitis. Any person who has been diagnosed with periartthritis of the shoulder typically complains of being unable to reach overhead, behind the head, out to the side, or behind the back in addition to a classic symptom of nocturnal pain, which will limit their ability to continue with repetitive activities. Adhesive

capsulitis affects 2% of the general population but is two to four times more common in the 11% of diabetics who have it. The incidence of diabetes is 38.6% in patients with adhesive capsulitis, whereas the prevalence of all diabetic conditions is 71.5% in people who also have adhesive capsulitis. Both type I and type II diabetic patients can develop shoulder capsulitis, but age and diabetes duration in type I patients are more strongly correlated with both types of diabetes. Additionally, it is discovered that sedentary employees are more at risk and the non-dominant leg is more impacted. According to reports, 10% to 38% of people with diabetes and thyroid conditions also have adhesive capsulitis. Patients with primary frozen shoulder often present between the ages of 40 and 65, and women are more likely than men to develop this condition.

Diagnosis

Clinical diagnosis of adhesive shoulder capsulitis is made based on medical history and physical examination, and it is frequently an exclusionary diagnosis. Before a diagnosis of adhesive capsulitis is made, other reasons of a painful stiff shoulder must be ruled out, such as septic arthritis, improper positioning of orthopaedic devices, fracture malunion, rotator cuff pathology, glenohumeralarthrosis, or cervical radiculopathy. Clinically, patients with this syndrome typically begin by complaining of shoulder pain, which is then gradually followed by a loss of both active and passive range of motion (ROM) as a result of fibrosis of the glenohumeral joint capsule. According to Boyle-Walker et al., the majority of patients (90.6%) reported experiencing shoulder pain prior to losing motion. On a clinical assessment, external rotation is frequently the first motion to be impair over the course of the disease. When the constricted capsule is stretched at the extremities of motion, pain is typically severe. Indicating a mechanical rather than a pain-related restriction to motion, passive ROM is lost with solid

painful endpoints of motion. Imaging tests may be useful to rule out alternative causes of a painful and stiff shoulder but are not necessary for the diagnosis of sticky shoulder capsulitis. In individuals with persistent adhesive capsulitis brought on by inactivity, plain shoulder films may show osteopenia (i.e. disuse osteopenia). Both magnetic resonance angiography (MRA) and magnetic resonance imaging (MRI) may show a narrowed glenohumeral joint space as well as thickening of the capsular and pericapsular tissues. According to Mengiardi et al, MRA results showing coracohumeral ligament (CHL) ligament thickness of 4mm or capsule thickness of 7mm (86% specificity, 64% sensitivity) may help in the diagnosis of adhesive capsulitis. A swelling of the joint capsule and restricted sliding motion of the supraspinatus tendon may be seen on dynamic sonography. These results are consistent with intraoperative direct imaging, which shows that the rotator interval and CHL have thickened most noticeably. Women have higher risk of AC with the passage of age than males. It ceases the life of patients and decreases the quality of life as it lasts up to variable time period usually 1-3 years.

Management of AC

Frozen shoulder is medically managed by the physiatrist, surgeon and rheumatologists but it is not well understood. AC can be managed operatively or none operatively but better techniques are still controversial. In survey of orthopaedic surgeons on United States, those performing operative management favored physiotherapy, while other using non operative management favored arthroscopic arthrolysis. Surgeon experience and training suggest the management method that holds the scientific evidences.

Treatment

Patient education increases compliance and reduces frustration. It helps to explain that the

situation will spontaneously improve and the stiffness will significantly decrease. It's crucial to stress that the complete range of motion might never return. The ideal course of action for frozen shoulder treatment would depend on the disease's stage. Treatment at the excruciating freezing stage the goal of treatment during the first painful freezing stages is to reduce discomfort. All pain-free activities are permitted, but all unpleasant activities should be avoided, and the patient is encouraged to utilise pain as a guide to limit activity. If a patient can handle them, non-steroidal anti-inflammatory medicines (NSAIDs) are typically given to them. These should, if necessary, be supplemented with other analgesics. The usefulness of NSAIDs in the specific problem of frozen shoulder, however, has not been supported by randomised controlled trials. Physiotherapy In a prospective research with 77 patients, Dierks et al. compared rigorous physiotherapy with activity under the pain threshold for those with frozen shoulder. In comparison to intense physiotherapy, they discovered that exercise within the pain threshold produced superior benefits (64% of participants attained close to pain-free shoulder movements at 12 months and 89% at 24 months) than it did (63% at 24 months). Steroid infusion, in a meta-analysis of studies on the use of intra-articular steroids, Hazelman found that the effectiveness of the therapy relies on how long the symptoms have been present; individuals who receive the injection earlier in the course of the illness recover more swiftly. Early steroid injection therapy into the intra-articular glenohumeral joint may lessen synovitis and shorten the disease's natural course. According to De Jong et al., the reaction to steroid injection depends on the dose. Carrette et al. compared the efficacy of PT alone with a single intra-articular steroid injection administered under x-ray control in a randomised placebo controlled experiment. In addition, patients receiving both physical therapy and steroid injections were examined in this study, as well as a fourth group of patients receiving saline injections as a

placebo. The authors came to the conclusion that while supervised physical therapy alone has modest benefits, it is helpful in relieving frozen shoulder discomfort and impairment when combined with a single steroid injection. A joint injection in basic care typically does not have access to X-ray control. In contrast, a different study by Van der Wind et colleagues found that at six weeks, steroid injection administered by a general practitioner was more efficient than physiotherapy alone. Other forms of therapy In a double-blind, randomised controlled experiment including 50 patients, Buchbinder et al. advocated oral steroids as a therapy for frozen shoulder. The frozen shoulder in this trial was initially improved by oral steroids, but their effects did not endure longer than six weeks. Oral steroids have known negative side effects, so they shouldn't be used as a standard treatment for this ailment. Repeated joint distension may improve movement, and suprascapular nerve blocks may be helpful for pain reduction (but not for movement). During the adhesive phase, treatment Since the inflammatory stage of the disease is ended, intra-articular steroid injections are not advised during the adhesive phase. The goal of treatment should be to recover range of motion, and more strenuous stretching activities will be allowed. Compared to the high tensile resistance found with high load, quick stretches, tissues elongate plastically during low load, extended stretching. Manipulation while unconscious The most effective technique to increase the range of motion in a frozen shoulder for patients who cannot bear the discomfort and incapacity brought on by the disease is manipulation while under anaesthesia. If the functional handicap continues for six months despite receiving adequate non-operative care, it is advised. Within three months after manipulation under anaesthesia, shoulder function and range of motion typically noticeably improve. Surgery for release In recent years, arthroscopic capsule release has been recommended as an alternative to manipulation under anaesthesia because it allows for a more

controlled relaxation of the constrained capsule. This is necessary if manipulation, which frequently happens in cases of frozen shoulder in people with diabetes, is unable to release the capsule. Additionally, consequences from manipulation, such as humerus fracture²⁴ and iatrogenic intra-articular shoulder lesions, are avoided with arthroscopic release. If synovitis is a crucial component in the development of frozen shoulder, arthroscopic release and synovectomy may be useful in slowing the disease's progression during the uncomfortable freezing phase.

Diabetes

One of the most significant issues facing public health in the twenty-first century is diabetes mellitus. It has been significantly underrated as a hazard to global health up to the past ten years. Because there is a dearth of precise data for monitoring and surveillance, there are significant gaps in efforts to understand the burden on a national and international level, particularly in poor countries. These demands are currently unmet because early attempts to gather correct data, mentioned in this article, appear to have been abandoned. International efforts now underway to compile information are woefully inadequate. Current estimates are approximate and likely understate the illness burden since they are not exact. The approaches currently in use and covered in this Perspectives article are insufficient for determining the prevalence of diabetes mellitus in a thorough and precise manner. It is necessary to build an international consensus on universal standards and criteria for reporting national data on the prevalence of diabetes mellitus, as well as for common complications of diabetes mellitus and mortality.

- The concept of developing T2DM at adult stage and type 1 Diabetes mellitus (T1DM) at very young stage is incorrect as both diseases can occur at both stages of ages. Difficulties related to T2DM are

diabetic ketoacidosis (DKA). Polyuria and polydipsia are associated with T1DM in children and one-third of them have DK which is first to be present in them. The symptoms of T1DM are different in children and adults so their onset is also different in adults and children. As the disease progresses the diagnosis becomes more apparent and clear. This heterogeneity should be kept in mind while treating the patient of T2DM.

Pre-diabetes or impaired fasting glucose

When blood sugar levels rise over normal but don't reach the diabetic range (110–126 mg/dL) when fasting, the condition is referred to as prediabetes or impaired fasting glucose (IFG). According to the International Diabetes Federation, there are 387 million persons with diabetes worldwide.

Risk factor of T2DM:

T2DM is linked to various diseases including pancreatic illness linked to cystic fibrosis or gestational diabetes that occurs in the second or third trimester of pregnancy. Application of glucocorticoid or active retroviral agents like nucleoside reverse transcription inhibitors and protease inhibitor for the HIV positive individuals can lead to the induction of T2DM in the patients. Thiazide diuretics, atypical antipsychotics, and statins may be used to treat chemical diabetes or impaired glucose tolerance (IGT).

Prevalence of diabetes in US:

According to the Centers for Disease Control and Prevention, diabetes was diagnosed in 29.1 million individuals in the US in 2012, or nearly 9.3% of the population. 86 million people found to have pre diabetic condition and 15 to 30% among them develop the diabetes in the same study. Every year 1.4 million new cases are adding in US. If this trend goes on like this then two in three Americans will have diabetes in 2050. Diabetes carries a number of dangers, including stroke, heart disease, renal failure, eyesight loss, and early mortality. Due to the

life-threatening illnesses it is associated with, diabetes is the seventh most common cause of mortality in the US. The death rate will double in number if diabetes remains an attendant by 2020, by WHO. Diabetes has more mortality rate than breast cancer and acquired immunodeficiency syndrome (AIDS) every year in America.

Management of T2DM

ADA has development recommendations to make better diabetic outcomes, one such recommendation is *Standard of Medical Care in Diabetes*. It has developed cheap screening, therapeutic and diagnostic strategies to control and manage T2DM and its complication. A team using contemporary methods should be included in the care of the patient and family, in accordance with the goals of the ADA and other organizations. The primary goal is to maintain optimum sugar level by proper medicines and maintain their diet and healthy lifestyles along with the regular checkup of glucose level.

Epidemiology of Diabetes

The late Kelly West's work, "Epidemiology of Diabetes and its Vascular Lesions," which was published in 1978, served as the catalyst for more focus on the epidemiology of diabetes mellitus and the requirement to develop globally recognised diagnostic criteria. The field of diabetes mellitus epidemiology was maturing, and this book anticipated its future as a key area of research. Almost all of the clinical and population-based contributions made on the topic of diabetes mellitus epidemiology up to that point were collected in West's book. It specifically brought to light the numerous knowledge gaps and the challenges in comparing studies.

The international workshop held in April 1978 by the US National Diabetes Data Group (NDDG), of the NIH, USA, and the conference hosted by the Kroc Foundation at the McDonald Ranch in the Santa Ynez Valley, close to Santa Barbara, California, USA, were significant turning points in the study of diabetes mellitus epidemiology. Diabetes Care released

the Kroc conference proceedings in March 1979, and they contain a wealth of discussion on classification, diagnostic standards, and suitable technique for epidemiological investigations of diabetes mellitus. Following these discussions, the WHO held its Second Expert Committee on Diabetes later that year. The WHO Expert Committee and NDDG11 On the categorization of the eligibility requirements for diabetes mellitus, reports provided recommendations.

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