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## Effect of blood sugar level on lower limb proprioception in diabetes

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### Abstract

Diabetes is fast gaining the status of a potential epidemic in India with more than 62 million diabetic individuals currently diagnosed with the disease. Proprioception is the ability to perceive position and movement. Proprioception can help in joint stability, postural correction (control) and many other conscious sensations. The aim is to identify the effect of blood sugar levels, both Fasting and Post Prandial sugar levels on Proprioception in Diabetic individual. It is a cross-sectional study with total of 30 subjects aged 45-59 years with a 5-10 years of diabetic history were included in the study and their blood sugar levels were examined using glucometer. Lower limb proprioception was assessed by Isokinetic Dynamometer. The results of data analysis demonstrated that fall in Blood sugar level leads to poor lower limb Proprioception in diabetic individuals. The Result came out to be significant at  $p < 0.05$ . The results demonstrated that changes in blood sugar levels is significantly correlated with poor proprioception in diabetic individuals as diabetes damages muscle spindle receptors which decreases proprioceptive input.

**Keywords:** Blood sugar level, proprioception, isokinetic dynamometer

### 1. Introduction

Diabetic Mellitus is a group of metabolic diseases characterized by hyperglycemia that results from defects in insulin secretion, insulin action on target tissue or both <sup>[1]</sup>. Diabetes is fast gaining the status of a potential epidemic in India with more than 62 million diabetic individuals currently diagnosed with the disease. In 2000, India (31.7 million) topped the world with the highest number of people with diabetes mellitus followed by China (20.8 million) with the United States (17.7 million) in second and third place respectively. According to Wild *et al.* the prevalence of diabetes is predicted to double globally from 171 million in 2000 to 366 million in 2030 with a maximum increase in India <sup>[2]</sup>.

Proprioception is the ability to perceive position and movement. This ability allows for the monitoring of the progression of any movement sequence and makes later movements possible. It is a sensory modality mediated by mechanoreceptors, which are receptors found in muscles and neuro-tendinous organs <sup>[3]</sup>.

Proprioception can help in joint stability, postural correction (control) and many other conscious sensations. Proprioception involves the senses of joint position and joint motion; it includes various sensory systems of muscles, tendons, joints, ligaments, skin, and organs of vision and balance <sup>[4]</sup>. The proprioceptive system provides the central nervous system (CNS) with information concerning angles and angular changes of joints <sup>[5]</sup>.

Physical functioning is a core element of health-related quality of life and predicts further functional decline, morbidity, health services use, and death. For example, compared with unimpaired individuals, people with impaired mobility have a 2-fold increased risk of falling, institutionalization, and death and 4-5 times the risk of functional dependenc. Diabetes may increase the risk of disability because of its wide-ranging complications, including cardiovascular and peripheral vascular disease, vision loss, and peripheral neuropathy <sup>[6]</sup>.

Many people suffering from long-standing diabetes have significant deficits in tactile sensitivity, vibration sense, lower limb Proprioception, and kinesthesia and absent ankle reflex which further falling <sup>[1]</sup>.

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DM patients have impaired knee joint proprioception, which could make the patients vulnerable to fall and could lead to subsequent fractures and increased the level of morbidity and mortality [4].

Epidemiological surveys have established that a reduction of leg proprioception is a risk factor for falls in the elderly. Proprioceptive information from the ankle joints the most important factor shaping the balance correction or are other sensory inputs, more directly related to the primary task of posture and gait, to maintain a stable torso of greater importance [7].

This research will highlight the effect of blood sugar level on lower limb proprioception in population suffering from diabetes. This might provide a window of opportunity for prevention and early treatment of diabetes-related locomotor deficits.

If any association is established with the utility of the present work then, it can form a body of knowledge for physiotherapeutic intervention to design a tailor made protocol on the basis of the results yielded. Thus creating a pivotal domain for the physiotherapist along with other team of the specialists to design proper exercise regimen for the patient with the proper guidelines in the management of diabetes so as to maintain the mobility, functional independence and preventing further deterioration thus improving quality of life of the patient.

## 2. Material and Method

### 2.1 Study design and Participants

The study population is a representative sample of the population living in New Delhi, India. The participants signed an informed consent before participating in the study.

### 2.2 Inclusion Criteria

Inclusion criteria includes diabetic subjects in the age group 45-59 years and with 5-10 years of diabetic history.

### 2.3 Exclusion Criteria

Exclusion criteria includes subjects with any neurological, musculoskeletal, infectious, systemic, metabolic disease, psychiatric diseases, pregnancy and subjects who are having hearing loss and any other communication problem.

### 2.4 Groups

Participants were divided into two groups-one group includes participants having diabetes and other group includes normal participants

### 2.5 Procedure

Subjects were selected depending upon inclusion and exclusion criteria. They were divided into 2 groups

Blood Sugar Levels both fasting and post prandial sugar levels were assessed by Blood Examination. Lower limb proprioception was assessed by Isokinetic Dynamometer. The subjects were seated and secured according to standard Biodex procedure using shin, thigh, pelvic, and upper crossing torso stabilization straps. Testing is first done on right side and then on left proprioception is tested at 15° and 45° of knee extension. As the leg is moving in extension, if subject feels that the point at which leg was stopped has arrived then he/she has to press the button and reading will be recorded. 3 repetitions will be done for each 15°, 45° angles.

## 3. Result and Discussion

Data was analyzed by t-test and expressed in form of Mean±

SD. P value <0.05 and <0.01 was considered as statistically significant. The result of data analyses demonstrated that there is significant statistical effect of Blood sugar levels on lower limb Proprioception in diabetic individuals. The Result came out to be significant at  $p < 0.05$ .

This study investigated correlation of blood sugar levels with lower limb proprioception in diabetic patients. This is in agreement with the study by Andersen and Jacobsen that showed that knee and ankle proprioception were reduced in patients with diabetes. These results were confirmed by Katoulis and colleagues who attributed reduced walking speed to diminished proprioception [5].

Ites *et al.* reported that, the diabetes decrease the action and function of the peripheral sense receptors especially the muscle spindles which could lead to balance and gait stability disturbance and impairment. The DM patients showed decrease of the reflex responses to postural perturbation, followed by decrease in the nerve conduction velocity, which lead to disturbance of the balance and increase the risk of falls [4].

Blood glucose concentrations must be maintained within narrow limits. This is essential to prevent the acute and chronic complications seen in diabetes mellitus and is achieved through a balance between the processes that add and remove glucose from the normal circulation [8].

The reduced joint proprioception makes obstacle negotiation difficult and increases the risk of fall. During the actual phase of obstacle crossing, an individual does not have complete visual information regarding clearance between the obstacle and foot, and thus relies on proprioception for the leading limb and feed-forward mechanism for the trailing limb. Therefore, especially among subjects with degraded balance and lost proprioception of joint position, the risk of contact with obstacle would be high [9].

Physical activity is being considered as a therapeutic intervention to ameliorate postural instability. Studies that analyzed the effects of proprioceptive exercise programs for individuals with diabetes report that balance and postural stability can be improved, probably by means of an increase in peripheral inference, leading to a reduction of falls related to sensory deficits [1].

**Table 1:** T-value of Variable

| Blood Sugar level         | Mean     | Standard Deviation | T-Value  |
|---------------------------|----------|--------------------|----------|
| Fasting Blood Sugar Level | 159.5385 | 43.83995           | 13.10372 |
| Post-Prandial Sugar Level | 247.3077 | 96.06519           | 9.274153 |
| Proprioception            | 0.21     | 0.06               | 13.10372 |

## 4. Conclusion

The results demonstrated that changes in blood sugar levels is significantly correlated with poor proprioception in diabetic individuals as diabetes damages muscle spindle receptors which decreases proprioceptive input. As we know that proprioception plays a major role in the conscious and unconscious awareness of a joint or limb in motion, preventing injury, determining speed of direction of movement, therefore it becomes very important that proprioception should be good. Also Sport, is recommended for all people with diabetes because it brings a range of health benefits such as improved sensitivity to insulin, improved. Therefore for effective sports performance of diabetic individuals good proprioception is necessary. Proprioception

and balance training might be beneficial for patients with diabetes, and this should be considered as a part of the rehabilitation program for these patients.

## 5. Presentation

Manuscript is presented as paper and published as conference proceedings in 4<sup>th</sup> National Conference on Physical Education and Sports Sciences organized by Physical Education foundation of India on 9<sup>th</sup> -10<sup>th</sup> February 2018 in New Delhi

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