

# Type 2 Diabetes and Edentulism as Chronic Co-Morbid Factors Affecting Indian Elderly: An Overview

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**Abstract** In past 50 years, type 2 diabetes has emerged as one of the major public health problem. India leads the world with the largest number of diabetic patients and has a huge elderly population. The present article discusses the effect of diabetes and edentulism on the overall general health of elderly. The prevalence of type 2 diabetes and edentulism in Indian elderly and their inter-relationship has been discussed. Dentists must provide optimum oral care with special attention towards comprehensive periodontal management and oral hygiene awareness among diabetics to prevent tooth loss. Dental and medical professionals can improve patient management of the oral and overall effects of diabetes by implementing various awareness programs; organizing camps; distributing informative pamphlets and dietary counseling. Dentists can detect undiagnosed cases of diabetes and refer patients to physicians for further evaluation and management.

**Keywords** Type 2 diabetes · Edentulism · Oral health · Inter-professional care

## Introduction

India's demographic contours suggest a steep rise in the elderly population. As per the 1991 census, the elderly population in India in the age group of 60 was 57 million, which had increased to 77 million in 2001 and is projected to rise to 179 million in 2031 [1]. India has thus acquired

the label of “an ageing nation” [2]. Data available suggests that almost 50 % of the Indian elderly suffer from one or more chronic diseases with the prevalence of the diseases increasing with rising age from 39 % in 60–64 years to 55 % in those older than 70 years [3].

## Chronic Illnesses Affecting the Indian Elderly

Different studies have shown varied results regarding the chronic morbidity conditions affecting the Indian elderly. An Indian Council of Medical Research (ICMR) report on the chronic morbidity profile in the elderly stated that hearing impairment is the most common morbidity [4]. A study conducted in the rural area of Pondicherry reported decreased visual acuity due to cataract and refractive errors in 57 % of the elderly followed by joint problems in 43.4 %, dental and chewing complaints in 42 %, and hearing impairment in 15.4 % [5]. A similar study that had been conducted among 200 elderly people in rural and urban areas of Chandigarh (Haryana) observed that as many as 87.5 % had minimal to severe disabilities. The most prevalent morbidity was anaemia, followed by dental problems, hypertension and several others [6]. A recent study conducted in 2010 reported diabetes as the second most prevalent medical illness, after hypertension in the urban Indian elderly aged 65 years and above [7].

Of all chronic conditions, diabetes has emerged as a major public health problem. The prevalence and incidence of diabetes mellitus have increased considerably over the past 50 years, and increases have been seen in both developed and developing nations. The status of diabetes has changed from being considered as a mild disorder to one of the major causes of morbidity and mortality affecting not only the elderly but also the middle aged

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adults. In many regions, up to 50 % of people with diabetes remain undiagnosed [8–10]. Many such patients would be visiting dentists for their oral care. Dental professionals can therefore play an important role in diagnosing and managing patients with diabetes and in screening for undiagnosed diabetes.

In the present paper, we will discuss diabetes and edentulism as chronic morbidity factors affecting Indian elderly.

## Diabetes Mellitus

Diabetes mellitus (DM) is a syndrome of abnormal carbohydrate, fat and protein metabolism that results in acute and chronic complications due to the absolute or relative lack of insulin. There are three general categories of diabetes: type 1, which results from an absolute insulin deficiency; type 2, which is the result of insulin resistance and an insulin secretory defect; and gestational, a condition of abnormal glucose tolerance during pregnancy [11].

### Prevalence of Type 2 Diabetes

#### *Global Prevalence*

Diabetes is one of the most prevalent diseases worldwide and has become a growing global health problem. Although there is an increase in the prevalence of type 1 diabetes, the more common, that is the type 2 diabetes, accounts for more than 90 % of all diabetes cases [12]. Among the elderly, type 2 diabetes is the fifth most common chronic condition and the sixth leading cause of mortality [13]. Prevalence of type 2 diabetes, in 2010, was estimated at 6.4 % affecting 285 million adults (aged 20–79 years) globally, and will increase to 7.7 % and 439 million adults by 2030. It has been estimated that between 2010 and 2030, there will be a 69 % increase in number of adults with diabetes in developing countries (like India) and a 20 % increase in developed countries. The overall total predicted increase in numbers with diabetes from 2010 to 2030 is 54 %, at an annual growth of 2.2 %, which is nearly twice the annual growth of the total world adult population. Thirty-six percent of the anticipated absolute global increase of 154 million people with diabetes is projected to occur in India and China alone [14].

#### *Prevalence in India*

India leads the world with the largest number of diabetic patients and has been declared as the “Diabetic Capital of the World” by the WHO [12]. A study on the global estimates of diabetes reported the total number of diabetic

patients in India to be around 50.8 million which are expected to increase to 87 million by the year 2030 [15].

Type 2 diabetes generally occurs after the age of 40 [16–19], and its prevalence increases with age, with a maximum peak between 65 and 74 years [16].

In India, more than half of the diabetics (53 %) are above 60 years and more than 85 % are above 45 years of age. Importantly, a high proportion of people with type 2 diabetes, 30–80 % in India [ICMR–INDIAB study] remain undiagnosed and thus untreated [20]. Diabetes has been reported as the second most prevalent medical illness (self-reported by the patient) among both the genders in the urban Indian elderly aged 65 years and above [7]. A study conducted in Kolkata reported prevalence of diabetes as 11 % in persons aged between 65 and 69 years [21]. In another study from Bhubaneswar (Orissa), prevalence of diabetes was found as high as 20 % in the age group of 65 & above [22].

## Edentulism in Indian Elderly

Edentulism is prevalent among older people all over the world. In developing countries limited access to oral health services often results in tooth extraction because of pain or discomfort, or because of lack of materials for dental treatment. Removable dentures are particularly frequent among the older people [23]. In India; prevalence of edentulousness of elderly has been reported as 19 % in the age group of 65–74 years [24, 25]. In the same age group, diabetes is the second most prevalent illness. A WHO study conducted in Delhi reported that in 35–44 year age group, 8 % of the study population were using partial dentures and 1 % were using complete dentures while in 65–74 year age group, 8 % were using partial dentures and 20 % were using complete dentures. Use of prosthesis was more common in urban than rural population [26]. A large number of elderly edentulous populations who might be diabetic would therefore be visiting dentists for removable denture services with estimates for an increasing demand in the future.

### Complete Edentulism and Diabetes

Studies on relationship between diabetes and complete edentulism are sparse. One study investigating the relationship of edentulism to diabetes reported that edentulous patients had 1.82 times greater risk of having diabetes than the dentate patient [27]. A cross-sectional study reported that functionally edentulous (6 or fewer teeth) older men had 4.06 times greater risk of developing type 2 diabetes, regardless of age or race, than those with partial or complete dentitions [28]. A large portion of denture wearing diabetic population

remains undiagnosed of their underlying systemic condition posing them to increased risk of developing oral diseases and denture-related complications.

### Diabetes and Tooth Loss

The susceptibility to periodontal disease is the most common oral complication of diabetes [29]. Although primarily related to the presence of dental plaque, periodontitis appears to be related to several pathological events associated with diabetes [30–32]. There is evidence that management of periodontal infections in patients with poorly controlled diabetes may actually help improve glycemic control [33]. Tooth loss is an inevitable result of periodontal disease [34, 35]. A study by Kapp reported that the number of missing teeth was significantly higher in patients with DM than the controls, although the suggested reason was the lack of oral health awareness and inadequate metabolic control [36].

Furthermore, because poorly controlled diabetes leads to significant morbidity and mortality, dentists can counsel their patients about improving glucose regulation, maintaining oral and nutritional health, performing daily glucose monitoring tests and seeing medical professionals for routine care [11].

Hence, type 2 diabetes and tooth loss act as chronic morbidity factors affecting the overall general health of the elderly.

### Diagnosis

WHO (1999) diagnostic criteria for diabetes require a fasting blood glucose level of 126 mg/dl or greater. The measurement of glycosylated haemoglobin, or HbA1c, is a good measure of long-term (6–12 weeks) glucose regulation [37].

The quality of glycemic control has been designated as “controlled” when the glycosylated hemoglobin level was <6.5 %, and “fairly controlled” when the level was 6.5–8.5 %, and “uncontrolled” when the level was >8.5 %.

### Diabetes-Oral Disease Connection: Role of the Dentist

Special consideration regarding the treatment of dental patients with diabetes must be taken into account in order to ensure that the oral care provided is safe and that the therapeutic outcomes are predictable. Special considerations include taking a thorough medical history, establishing communication with treating physician and performing careful intra-oral evaluation, including a comprehensive periodontal assessment.

### History-Taking

A large number of diabetic patients (diagnosed & undiagnosed) routinely seek dental treatments. The importance of taking medical history therefore cannot be overemphasized. Dental settings can become healthcare locations actively involved in screening for unidentified diabetes. Questioning for the cardinal signs and symptoms of diabetes, asking for family history of diabetes and other systemic conditions by the dental practitioner will help in identifying undiagnosed diabetes.

A survey conducted in Northern India by Singh et al. [38] regarding the taking of case history by 700 private dental practitioners before starting dental treatment showed that 71 % of the practitioners took the case history orally while 23 % took the history in a record and only 19.2 % maintained the record.

It is reported by Zarb GA et al. [39] that both new and returning patients require complete history taking and dentists must be aware of the patient’s general health and conditions that might influence the choice of the treatment and help avoid complications. The findings of the above survey [38] are however contrary to this. It is emphasized that history-taking and patient record maintenance should not be overlooked by the clinician and be integrated in day-to-day clinical practice.

### Intra-oral Evaluation

#### *Oral Findings Associated with Diabetes*

Diabetes mellitus is associated with increased risk of periodontal disease, root caries [40] and inevitably tooth loss. A greater prevalence of burning mouth syndrome, dry mouth, angular cheilitis, and glossitis has been observed [41]. An increased risk of infections has been observed with reduced salivary flow, low salivary buffering capacity [42], night-wearing and inadequate hygiene of the complete dentures [43]. Special care on the part of the dentist in terms of diagnosis and clinical examination is necessary, since subjects commonly report specific symptoms such as a sensation of dry mouth and burning, mastication and speech difficulties, dry lips, altered taste, and a lack of adaptation to the complete denture [44]. The maintenance of oral health and prevention of oral diseases are associated with the systemic health [45].

#### Screening for Undiagnosed Diabetes Based on Associated Oral Findings

##### *Periodontal Disease and Tooth Loss*

Borrell et al. [46] explored the ability of clinical periodontal findings, to identify patients with undiagnosed diabetes (i.e., those with an FPG  $\geq$  126 mg/dl among those

who responded negatively to the question, Have you ever been told by a doctor that you have diabetes?).

The first study to prospectively collect data in a clinical setting in order to single out a simple and efficient protocol to identify people with undiagnosed pre-diabetes or diabetes, revealed that two dental parameters (number of missing teeth and percent of deep periodontal pockets) were effective in correctly identifying the majority of cases with unrecognized dysglycemia [47].

*Oral Mucosal Disorders*

Diabetes is associated with a greater likelihood of developing certain oral mucosal disorders [48]. There are reports of greater prevalence's of lichen planus [49] and recurrent aphthous stomatitis [50], as well as oral fungal infections. Oral mucosal disorders represent an opportunity to coordinate diabetes care between physicians and dentists, which can improve the referral of patients to oral health practitioners [51].

*Oral Infections (Candidiasis)*

Fungal infections of oral mucosal surfaces and removable prostheses are more commonly found in adults with diabetes. *Candida pseudohyphae*, a cardinal sign of oral *Candida* infection, have been associated significantly with cigarette smoking, use of dentures in conjunction with poor oral hygiene and poor glycemic control in adults with diabetes [52]. Salivary hypofunction also may increase the oral candidal carriage state in adults with diabetes [53, 54]. Patients with NIDDM had a significantly higher prevalence of candida-associated denture stomatitis [55, 56].

The oral health care professionals can readily make the diagnosis of oral candidiasis and denture stomatitis and provide appropriate therapy [57], but most importantly, they should identify the infection's etiology, which could include a diagnosis of DM.

*Burning Mouth Syndrome*

Diabetes has been associated with oral burning symptoms; [58, 59] however, neuropathy from diabetes is typically associated with pain and burning in other parts of the body, such as the feet [60]. Of particular significance is the finding that symptoms of burning mouth or tongue have been found in undiagnosed cases of type 2 diabetes, most of which resolved after medical diagnosis and subsequent treatment directed at improving glycemic control [61].

Screening for Undiagnosed Diabetes in India

Screening for undiagnosed diabetes is commonly recommended in India as a means of improving outcomes

through minimizing the impact of diabetes complications. The large population and urban–rural differences of diagnosed to undiagnosed diabetes make population screening impractical in India. Studies shows that the majority of people presenting with newly diagnosed diabetes are asymptomatic, therefore, opportunistic screening of asymptomatic individuals would be required to detect the majority of people with currently undiagnosed diabetes and should be considered as part of a medical and dental check-up for unrelated conditions [62].

Patients visiting dentists often return for multiple non-emergency visits. Medical history, family history, oral findings associated with diabetes can help detect undiagnosed diabetes. In addition to this, dental professionals can assess risk factors (Table 1); refer for testing or “formally” screen, and follow-up on outcomes.

Early Identification and Prevention: The Indian Diabetes Risk Score (IDRS)

Identification of individuals who are at risk is extremely important if we are to prevent diabetes in India. Early identification of the high risk individuals would help in taking appropriate intervention in the form of dietary changes and increasing physical activity, thus helping to prevent, or at least delay, the onset of diabetes.

The Indian Diabetes Risk Score (IDRS) uses four simple variables namely, age, family history, regular exercise and waist circumference (Table 2) [63]. The individuals are classified as having high risk (score > 60), moderate risk (score 30–50) and low risk (score < 30) out of a total score of 100. IDRS has a sensitivity and specificity of over 60 per cent for a cut-off >60 and can be used to do a selective screening for Indian population.

Inter-professional Relationships in Patient Care and Awareness

Comprehensive care for diabetes and dental problems is a team effort involving both the patient and a system of health care professionals.

Dental professionals must discuss with their patients the link between oral and general health, how diabetes and

**Table 1** Risk factors associated with diabetes

Modifiable risk factors	Non-modifiable risk factors
Obesity	Family history
Physical inactivity	Genetic factors
Plasma lipids and lipoproteins levels	High/low birth weight (intra-uterine environment exposure)
Hypertension	
Dietary habits	

**Table 2** Indian Diabetes Risk Score (IDRS)

Particulars	Score
Age (years)	
<35 (reference)	0
35–49	20
>50	30
Abdominal obesity	
Waist <80 cm (female), <90 (male) (reference)	0
Waist >80–89 cm (female), >90–99 cm (male)	10
Waist >90 cm (female), >100 cm (male)	20
Physical activity	
Vigorous exercise or strenuous (manual) labour at home/work	0
Mild to moderate exercise or mild to moderate physical activity at home/work	20
No exercise and sedentary activities at home/work	30
Family history	
No family history (reference)	0
Either parent	10
Both parents	20
Minimum score	0
Maximum score	100

Interpretation: Score < 30 low risk, score 30–50 medium risk and score > 60 high risk for type 2 diabetes and cardiovascular diseases

Source: Mohan et al. [12]. The risk score was Modified from Ref. [63] by the authors

periodontitis interrelate, and the need for co-management of their condition by multiple healthcare providers; given that studies suggest that oral disease awareness among diabetic individuals is rather low [64–69].

A significant association has been found between glycemic control and oral infections and between duration of diabetes and denture problems. In order to promote proper oral health and to reduce risk of oral diseases, health professionals need to develop programs to educate the public about the oral manifestations of diabetes and its complications [70].

A recent study conducted in Belgaum (Karnataka) evaluated patients' knowledge regarding the post-insertion care of complete denture prosthesis [71]. The study concluded that the edentulous patients surveyed had limited awareness of prostheses hygiene and long-term oral care.

Plaque levels increase in the presence of removable partial dentures, coupled with inadequate denture hygiene and night-wearing will increase susceptibility to oral complications in diabetic patients. It is necessary to motivate patients and increase awareness regarding adequate hygiene maintenance. Supervision and monitoring of denture cleanliness can be done by dentists using plaque-closing tablets at recall appointments.

Clinical protocols and guidelines should be in place in every dental practice setting for determining frequency of follow-up care, determining the need for referral to a dental specialist, and for the need for medical consultation, referral, and follow-up.

Medical care providers need to discuss with their diabetic patients the importance of oral health and its relationship to diabetes and the potential sequelae of long-standing, untreated oral infections. All diabetic patients should be advised to see a dentist on a regular basis. Screening for oral/periodontal changes must be part of the assessment of diabetic patients, similar to the screening for other complications. Asking about symptoms and performing an oral examination is simple and should be a part of the medical provider–patient interaction. In addition, medical care providers should also facilitate communication with the treating dentist by offering information on the patient's medical background, level of glycemic control, and presence of other complications and co-morbidities [72].

Medical care providers must also consider the fact that edentulism is associated with reduced functional efficiency and concomitant dietary selectivity [73–75]. It is presumptuous to expect good dietary compliance from patients with compromised masticatory function. Trends have shown that completely edentulous persons tend to avoid protein, fiber, fresh fruits, and vegetables in favor of softer foods rich in carbohydrates and saturated fats [76]. Medical care providers and dentists need to be aware of this limitation and alter therapeutic strategies in a way that is designed to enhance dietary control.

## Summary

The proportion of older people continues to grow worldwide, especially in developing countries. This, along with an increase in the prevalence of diabetes and concomitant oral diseases is a significant health and economic burden. Medical and dental professionals can improve patient management of the oral and overall effects of diabetes by implementing various awareness programs/campaigns; organizing camps; distributing informative pamphlets and dietary counseling. Dental settings can help in screening for unidentified diabetes. Early identification of at risk individuals and appropriate intervention could greatly help to prevent, or at least delay the onset of diabetes and thus reduce the burden due to non communicable diseases in India.

**Conflicts of Interest** None.

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