

Prevalence of Oral Candidiasis in Diabetic Patients at Northern of Kingdom of Saudi Arabia

¹Bader K. Alzarea, ¹Mohd G. Sghaireen, ²Ibrahim Taher and ²Mazin Mohager

¹Department of Prosthodontics, Faculty of Dentistry,

²Department of Medical Microbiology, Faculty of Medicine,
Aljouf University, Sakaka, Saudi Arabia

Abstract: Diabetes has become increasing in prevalence all over the world. Diabetes is associated with certain diseases such as Candidiasis. The objectives of the present study were to estimate the prevalence of *Candida* species in the oral cavity of diabetic and non-diabetic individuals at Al-Gurayat Governorate, Kingdom of Saudi Arabia and to evaluate the effects of smoking and denture wearing on the prevalence of *Candida*. A cross sectional study design was involved to collect data from all participants at within the time frame. Study sample included 100 patients with diabetes and 100 non-diabetics as a reference group. A questionnaire was constructed to collect data. Various oral sites were swabbed and cultured on Brain Heart Infusion (BHI) broth and inoculated on Sabouraud's dextrose agar and incubated at 37°C for 48 h. Study findings showed that the prevalence of *Candida* among diabetics was 70% and among non-diabetic group was 30%. The prevalence of *Candida* among diabetic group was significantly associated with oral hygiene ($p = 0.000$), gingivitis ($p = 0.004$) and denture wearing ($p = 0.002$). Taken together, the results of the present study clearly showed that diabetic patients are more likely to develop *Candida* infection compared with non-diabetics. Candidiasis was significantly associated with oral hygiene, gingivitis and denture wearing.

Key words: Diabetes, *Candida*, denture, smoking, oral hygiene, gingivitis

INTRODUCTION

It has been reported that fungal infections have increased importance due to the wide use of antibiotics, corticosteroids, anti-tumoural agents and oral contraceptives (Bremenkamp *et al.*, 2011). It has also been found that the increasing cases of immuno compromised patients participates in giving importance of fungal infections (Burchard, 1992).

Several studies have pointed to the possibility of developing candidosis by diabetic patients (Ueta *et al.*, 1993; Kapur *et al.*, 1997; Garcia-Humbria *et al.*, 2005). It has been shown that there are several pathogenic mechanisms explaining high prevalence of infections among diabetic patients including lowered immunity, angiopathy, neuropathy as well as increased medical interventions (Geerlings and Hoepelman, 1999).

It has been proposed that diabetic patients are likely to develop fungal infections due to high glucose level which in turn, improves the growth of yeast in oral cavity (Bartholomew *et al.*, 1987; Oksala, 1990; Darwazeh *et al.*, 1991; Lamey *et al.*, 1992).

In their study, Wild *et al.* (2004) reported increased prevalence of diabetes mellitus mainly among people with the age of 60 years and older. Furthermore, it has been estimated that there are 171 million persons with diabetes in 2000 and this number is expected to reach 366 million persons in 2030. Researchers believed that the increased prevalence is due to several factors such as increased growth of population, increased life of people and factors related to urbanization such as increased rates of obesity and physical inactivity.

Bremenkamp *et al.* (2011) found no significant differences in colonization of *Candida* sp., oral isolates from type 1 and 2 diabetes when compared to matched controls. The study of Hammad *et al.* (2013) found that diabetic patients developed candidiasis in 59 and 48.7% of tongue and subgingival plaque, respectively. Subgingival *Candida* was shown to be more prevalent among females compared with males ($p = 0.041$). It was also found that controlling of diabetes was significantly correlated with the prevalence of subgingival *Candida* ($p = 0.047$) and the severity of gingival disease ($p = 0.047$). Taken together, researchers concluded that both poor

glycemic control and female gender were associated with increased subgingival *Candida* in patients with type 2 diabetes. In their study, Lamey *et al.* (1988) have put emphasis on the consideration that diabetic patients have the potential for developing oral *Candida* colonization and infection (Rayfield *et al.*, 1982; Darwazeh *et al.*, 1991).

In Saudi Arabia, Al Mubarak *et al.* (2013) conducted a study to determine the prevalence of *Candida* sp. in periodontitis patients with type 2 diabetes mellitus. The results showed that the overall prevalence of *Candida* in diabetic patients with periodontitis was 52%. The results also indicated that males were more likely to develop *Candida* infection than females. Age was also another significant contributing factor for developing *Candida*, particularly over the age of 40 years.

In Jordan, Abu-Elteen *et al.* (2006) conducted a study to determine the prevalence, species distribution and antifungal susceptibility profile among oral cavity isolates of *Candida* species from diabetic and non-diabetic subjects and to identify the extent by which smoking and dental status contribute to the prevalence and distribution of *Candida* species. Study findings showed that the prevalence of *Candida* was 58.3% among diabetics compared with 30% among control group ($p < 0.001$). The detection of *Candida* was more prevalent in diabetic denture wearers than in control counterparts ($p < 0.05$). Both diabetic and control groups exhibited significant prevalence of *Candida* among smokers compared with non-smokers ($p < 0.001$).

Study objectives: The aims of this study were to estimate the prevalence of *Candida* species in the oral cavity of diabetic and non-diabetic individuals at Al-Gurairat Governorate, Kingdom of Saudi Arabia and to evaluate the effects of smoking and denture wearing on the prevalence of *Candida*.

MATERIALS AND METHODS

Study design: A cross-sectional study design was used to collect data from study participants.

Study sample: Study sample included 100 patients with diabetes mellitus and 100 persons, non-diabetic as a control group.

Study setting: Patients who attended dental school student's clinics at Sakaka, KSA were recruited to participate in the present study.

Data collection: A questionnaire was prepared to collect data from participants. Demographic and dental data were

included. Participants signed a consent form after they had understood that their participation is voluntary and only for research purposes.

Sample collection: Samples collected from different oral sites using a sterile swab, the swabs were transported in Brain Heart Infusion (BHI) broth and inoculated on Sabouraud's dextrose agar and incubated at 37°C for 48 h.

Identification of Candida: Classical methods for identification of *Candida* were used to identify yeast-like growth. Germ tube test, hyphae/pseudohyphae and chlamydospores growth, carbohydrate fermentation and assimilation and urea hydrolysis and by subculture of 2-3 representative colonies on CHROMagar. These identification methods were followed in other studies (Abu-Elteen *et al.*, 2006; Al Mubarak *et al.*, 2013).

Statistical analysis: All data were analyzed using SPSS Version 20. General characteristics of study participants were represented as frequencies and percentages. Continuous variables such as age were represented as mean and standard deviation. The relationships between variables were tested using Chi-square. The significance was considered at alpha level ≤ 0.05 .

RESULTS AND DISCUSSION

As shown in Table 1, the study included 100 diabetic patients. The mean age was 45.44±7.21 years. Of 100 diabetic patients, 49% were males, 95% married, 23% with good oral hygiene, 45% smokers, 66% with gingivitis, 26% with dentures and 70% were positive for *C. albicans*.

Table 1: General characteristics of diabetic participants

Variables	Description
Age (M±SD)	45.44±7.21
Gender (N, %)	
Male	49 (49%)
Female	51 (51%)
Marital status (N, %)	
Married	95 (95%)
Single	5 (5%)
Oral hygiene (N, %)	
Good	23 (23%)
Poor	77 (77%)
Smoking (N, %)	
Yes	45 (45%)
No	55 (55%)
Gingivitis	
Yes	66 (66%)
No	34 (34%)
Using dentures	
Yes	26 (26%)
No	74 (74%)
<i>Candida albicans</i>	
Positive	70 (54%)
Negative	30 (46%)

Non-diabetic group included 100 persons. The age mean was 40.22±6.96 years. There were 87% males, 99% married, 29% with good oral hygiene, 24% smokers, 27% with gingivitis, 2% used dentures and *C. albicans* was detected in 28% of persons (Table 2).

The relationship between *Candida albicans* and other study variables among diabetic participants: The relationship between *Candida albicans* and other study variables among diabetic participants was investigated. As shown in Table 3, there was a statistically significant relationship between *C. albicans*

and oral hygiene (p = 0.000), *C. albicans* and gingivitis (p = 0.002) and *C. albicans* and dentures (p = 0.004).

The relationship between *Candida albicans* and other study variables among non-diabetic participants: As shown in Table 4, there were no significant statistical relationships between *C. albicans* and other study variables (p>0.05 for all variables).

The present study showed that the prevalence of *Candida* among diabetic patients at Sakaka, KSA was 70% and for non-diabetics was 30%. No previous studies have determined the prevalence of *Candida* among diabetics in the same area. According to the study of Akpan and Morgan (2002), the prevalence of oral Candidiasis in various countries was estimated to differ according to age, sex, location and clinical status and has been reported to range from 20-75% without any symptoms.

The study of Al Mubarak *et al.* (2013) showed less prevalence of *Candida* among diabetics (52%) in KSA than the present study.

The prevalence of our study is also higher than that reported by the study of Abu-Elteen *et al.* (2006) who reported 58.3% of *Candida* among diabetic persons in Jordan but our findings are in line with Abu-Elteen about the prevalence of *Candida* among non-diabetics since, both studies showed 30% prevalence. Other studies reported 30-45% of *Candida* in healthy individuals (Lucas, 1993).

Our findings showed a significant relationship between the prevalence of *Candida* and oral hygiene (p = 0.000). The diabetics with good oral hygiene were less likely to be colonized by *Candida*. It is obvious that

Table 2: General characteristics of non-diabetic participants

Variables	Description
Age (M±SD)	40.22±6.96
Gender (N, %)	
Male	87 (87%)
Female	13 (13%)
Marital status (N, %)	
Married	99 (99%)
Single	1 (1%)
Oral hygiene (N, %)	
Good	29 (29%)
Poor	71 (71%)
Smoking (N, %)	
Yes	24 (24%)
No	76 (76%)
Gingivitis	
Yes	27 (27%)
No	73 (73%)
Using dentures	
Yes	2 (2%)
No	98 (98%)
<i>Candida albicans</i>	
Positive	28 (28%)
Negative	72 (72%)

Table 3: The relationship between *Candida albicans* and other study variables among diabetic participants

Variables	<i>C. albicans</i>				p-values
	Positive		Negative		
	N	%	N	%	
Gender					0.150
Male	31	44.3	18	60	
Female	39	55.7	12	40	
Marital status					0.133
Married	65	92.9	30	100	
Single	5	7.1	0	0	
Oral hygiene					0.000
Good	9	12.9	14	46.7	
Poor	61	87.1	16	53.3	
Smoking					0.511
Yes	30	42.9	15	50	
No	40	57.1	15	50	
Gingivitis					0.002
Yes	53	75.7	13	43.3	
No	17	24.3	17	56.7	
Dentures					0.004
Yes	24	32.1	2	6.7	
No	46	67.9	28	93.3	

Table 4: Relationships between the oral *Candida albicans* and other study variables among non-diabetic participants

Variables	<i>C. albicans</i>				p-values
	Positive		Negative		
	N	%	N	%	
Gender					0.812
Male	24	85.7	63	87.5	
Female	4	14.3	9	12.5	
Marital status					0.107
Married	27	96.4	72	100	
Single	1	3.6	0	0	
Oral hygiene					0.298
Good	6	21.4	23	31.9	
Poor	22	68.1	49	68.1	
Smoking					0.884
Yes	7	25	17	23.6	
No	21	75	55	76.4	
Gingivitis					0.221
Yes	10	35.7	17	23.6	
No	18	64.3	55	76.4	
Dentures					0.373
Yes	0	0	4	5.6	
No	28	100	68	94.4	

good oral hygiene implies less probabilities for Candida growth and subsequently less gingivitis. The study of Javed *et al.* (2012) did not show a significant association between the prevalence of Candida and oral hygiene and this may be due to the nature of his pre-diabetic sample.

The prevalence of Candida associated significantly with gingivitis ($p = 0.004$). Our findings agree with other reported studies in literature (Murillo *et al.*, 2008; Javed *et al.*, 2012).

A significant association was observed between the prevalence of Candida and denture wearing ($p = 0.002$). The study findings are consistent with other studies in which the incidence of Candida isolated from the oral cavity has been reported to be 50-65% in people with removable dentures (Abu-Elteen and Abu-Alteen, 1998), 52% in elderly denture wearers (Hamster *et al.*, 2010) and 85% in denture wearers (Arirachakaran *et al.*, 2013).

CONCLUSION

The results of the present study clearly showed that diabetic patients are more likely to develop Candida infection compared with non-diabetics. Candidiasis was significantly associated with oral hygiene, gingivitis and denture wearing.

REFERENCES

Abu-Elteen, K.H. and R.M. Abu-Alteen, 1998. The prevalence of *Candida albicans* populations in the mouths of complete denture wearers. *Microbiologica*, 21: 41-48.

Abu-Elteen, K.H., M.A. Hamad and S.A. Salah, 2006. Prevalence of oral Candida infections in diabetic patients. *Bahrain Med. Bull.*, 28: 1-8.

Akpan, A. and R. Morgan, 2002. Oral candidiasis: A review. *Postgrad. Med. J.*, 78: 455-459.

Al Mubarak, S., A.A. Robert, J.K. Baskaradoss, K. Al-Zoman and A. Al Sohail *et al.*, 2013. The prevalence of oral Candida infections in periodontitis patients with type 2 diabetes mellitus. *J. Infect. Public Health*, 6: 296-301.

Arirachakaran, P., P. Piboonratanakit, P. Kiatkroekkrai, M. Sorntmai and N. Srimart, 2013. Prevalence of oral Candida carriage in denture wearers Chulalongkorn Univ. Dent. J., 32: 101-112.

Bartholomew, G.A., B. Rodu and D.S. Bell, 1987. Oral candidiasis in patients with diabetes mellitus: A thorough analysis. *Diabetes Care*, 10: 607-612.

Bremenkamp, R.M., A.R. Caris, A.O.C. Jorge, G.N. Back-Brito and A.J. Mota *et al.*, 2011. Prevalence and antifungal resistance profile of *Candida* sp., oral isolates from patients with type 1 and 2 diabetes mellitus. *Arch. Oral Biol.*, 56: 549-555.

Burchard, K.W., 1992. Fungal sepsis. *Infect. Dis. Clinics North Am.*, 6: 677-692.

Darwazeh, A.M.G., T.W. MacFarlane, A. McCuish and P.J. Lamey, 1991. Mixed salivary glucose levels and candidal carriage in patients with diabetes mellitus. *J. Oral Pathol. Med.*, 20: 280-283.

Garcia-Humbria, L., N. Richard-Yegres, M. Perez-Blanco, F. Yegres and M. Mendoza *et al.*, 2005. Superficial mycoses: Comparative study between type 2 diabetic patients and a non-diabetic control group. *Investigacion, Clin.*, 46: 65-74.

Geerlings, S.E. and A.I. Hoepelman, 1999. Immune dysfunction in patients with Diabetes Mellitus (DM). *FEMS Immunol. Med. Microbiol.*, 26: 259-265.

Hamster, M., L. Wanderley, J. Brustolin and A.M. Fuentefria, 2010. Incidence of *Candida* sp., in oral cavity of elderly with removable, total or partial, dental prosthesis in the City of Coronel Freitas, State of Santa Catarina, Brazil. *Rev. Panam. Infectol.*, 12: 17-22.

Hammad, M.M., A.M. Darwazeh and M.M. Idrees, 2013. The effect of glycemic control on Candida colonization of the tongue and the subgingival plaque in patients with type II diabetes and periodontitis. *Oral Surg. Oral Med. Oral Pathol. Oral Radiol.*, 116: 321-326.

Javed, F., M. Al-Askar, A. Al-Rasheed, N. Babay, P. Galindo-Moreno and K. Al-Hezaimi, 2012. Comparison of self-perceived oral health, periodontal inflammatory conditions and socioeconomic status in individuals with and without prediabetes. *Am. J. Med. Sci.*, 344: 100-104.

Kapur, A., R. Vasudeva and C.W. Howden, 1997. Candida splenic abscess in the absence of obvious immunodeficiency. *Am. J. Gastroenterol.*, 92: 509-512.

Lamey, P.J., A. Darwaza, B.M. Fisher, L.P. Samaranayake, T.W. MacFarlane and B.M. Frier, 1988. Secretor status, candidal carriage and candidal infection in patients with diabetes mellitus. *J. Oral Pathol. Med.*, 17: 354-357.

Lamey, P.J., A.M.G. Darwazeh and B.M. Frier, 1992. Oral disorders associated with diabetes mellitus. *Diabetic, Med.*, 9: 410-416.

Lucas, V.S., 1993. Association of psychotropic drugs, prevalence of denture-related stomatitis and oral candidosis. *Community, Dent. Oral Epidemiol.*, 21: 313-316.

- Murillo, J., Y. Wang, X. Xu, R.J. Klebe and Z. Chen *et al.*, 2008. Advanced glycation of type I collagen and fibronectin modifies periodontal cell behavior. *J. Periodontology.*, 79: 2190-2199.
- Oksala, E., 1990. Factors predisposing to oral yeast infections. *Acta Odontol.*, 48: 71-74.
- Rayfield, E.J., M.J. Ault, G.T. Keusch, M.J. Brothers, C. Nechemias and H. Smith, 1982. Infection and diabetes: The case for glucose control. *Am. J. Med.*, 72: 439-450.
- Ueta, E., T. Osaki, K. Yoneda and T. Yamamoto, 1993. Prevalence of diabetes mellitus in odontogenic infections and oral candidiasis: An analysis of neutrophil suppression. *J. Oral Pathol. Med.*, 22: 168-174.
- Wild, S., G. Roglic, A. Green, R. Sicree and H. King, 2004. Global prevalence of diabetes estimates for the year 2000 and projections for 2030. *Diabetes Care*, 27: 1047-1053.