Neurology, Psychiatry and Brain Research 32 (2019) 36–41

Contents lists available at ScienceDirect

Neurology, Psychiatry and Brain Research

journal homepage: www.elsevier.com/locate/npbr

Periodontal predicaments and associated risk factors among patients with schizophrenia

Abhinav Singh[a,*], Bharathi M. Purohit[b], Pankaj Mittal[c]

[a] Deptt. of Dentistry, All India Institute of Medical Sciences (AIIMS), Ministry of Health & Family Welfare, Government of India, Bhopal, India
[b] Deptt. of Dentistry, All India Institute of Medical Sciences (AIIMS), Ministry of Health & Family Welfare, Government of India, Patna, India
[c] Deptt. of Psychiatry, All India Institute of Medical Sciences (AIIMS), Ministry of Health & Family Welfare, Government of India, Bhopal, India

ARTICLE INFO

Keywords:
Loss of connective tissue attachment
Oral health
Periodontal disease
Schizophrenia

ABSTRACT

Aim: The aim of this study is to evaluate association between periodontal health including loss of connective tissue attachment with schizophrenia and to estimate the associated risk factors.
Methods: A total of 156 schizophrenic patients based on ICD-10 criteria participated in the study. Dental examinations were conducted as per WHO (1997) criterion. Community Periodontal Index (CPI) and loss of connective tissue attachment (LOA) was used to assess the periodontal health. Chi Square and Mann – Whitney *U* test were used to compare between two or more groups for categorical and quantitative variables. Logistic regression analysis was performed to determine association of independent variables with periodontal pockets and loss of attachment Significance was set at ≤ 0.05.
Results: Periodontal pockets and loss of connective tissue attachment (LOA) were noted among 109 (69.8%) and 89 (57%) study participants respectively. Mean number of sextants with periodontal pockets were 2.76 ± 0.39 and 1.98 ± 0.45 among male and female study participants ($p \leq 0.001$). Mean number of sextants with attachment loss were 1.47 ± 0.43 and 0.87 ± 0.37 respectively ($p \leq 0.001$). Age, socioeconomic status, tobacco consumption, admission to psychiatric facility, duration of illness and co-morbidities were associated with periodontal pockets and loss of connective tissue attachment.
Conclusion: Patients with schizophrenia had poor periodontal health and were associated with high periodontal breakdown and loss of connective tissue attachment scores. Efforts need to be focused on strengthening the evidence of its association through further studies including cohort investigations.
Clinical Relevance: This is the first study to evaluate periodontal predicaments, specifically loss of connective tissue attachment among patients with schizophrenia.

1. Introduction

Schizophrenia is a chronic and severe mental disorder that affects how a person thinks, feels, and behaves and has been associated with a range of physical co-morbidities, ascribed to their sedentary life-style, debilitated self-care and the side effects from psychotropic medications (Fleischhacker et al., 2008). Due to chronic course of illness, identifying and managing these physical conditions is critically important in this population. Among these conditions, the clinical relevance of periodontal disease is often underestimated while conditions like hypertension, diabetes mellitus, osteoporosis and dental caries have received wider attention (Bertaud-Gounot, Kovess-Masfety, Perrus, Trohel, & Richard, 2013).

Patients with schizophrenia experience attrition of performance in day-to-day life over a period of time (Khokhar, Clifton, Jones, & Tosh, 2011). It diminishes a person's abilities in the areas of social relations, school or work and self-care. During an episode of illness, patients with schizophrenia experience the world in a profoundly confused way, which often is disturbing and frightening for them. Although schizophrenia is not as common as other mental disorders, the symptoms can be very disabling. Symptoms begin usually in young adulthood, and about 0.3–0.7% of people are affected during their lifetime (Global Burden of Disease Study, 2013). In 2013, there was projected to be 23.6 million cases globally. In India, where about 1.2 billion people reside, the prevalence of schizophrenia is about 3/1000 individuals (Loganathan & Murthy, 2011).

Periodontal disease is a pathological condition characterized by bacterial challenge that can initiate a destructive host response leading to periodontal attachment loss, bone loss and ultimately to possible tooth loss. Periodontal diseases affect the supporting structures of teeth,

* Corresponding author.
E-mail addresses: drabhinav.singh@gmail.com (A. Singh), bharathipurohit@gmail.com (B.M. Purohit), drpankajmittalpcj@gmail.com (P. Mittal).

https://doi.org/10.1016/j.npbr.2019.03.008
Received 21 September 2018; Received in revised form 5 March 2019; Accepted 25 March 2019
Available online 29 March 2019

namely gingival, periodontal ligament and alveolar bone. A thin, adherent microbial film on tooth surfaces called dental plaque is main pathological cause of gingival and periodontal inflammation. Periodontitis does not affect all individuals in population the same way. Multiple factors, such as poor oral hygiene, systemic conditions, medications, socio-economic disadvantages, inadequate access to care, behavioural problems and decreased motor function, may be responsible for periodontal disease (Eltas, Kartalci, Eltas, Dündar, & Uslu, 2013; Yousef, 2014). However, the causative agents implicated in the disease are often not enough to cause the common clinical signs of inflammation, bleeding and attachment loss. This observation has led to search for other risk factors associated with the disease.

In recent years, there has been increasing interest in dental health among patients with schizophrenia (Eltas et al., 2013; Nielsen, Munk, Skadhede, & Correll, 2011; Yousef, 2014; Chu, Yang, Chou, Chiu, & Chi, 2010; Janardhanan, Cohen, Kim, & Rizvi, 2011; Tani, Uchida, & Suzuki, 2012; Lisa, Lloyd, David, Jason, & Peter, 2013). This is probably related to an interest in improving the physical health, integration in the community, quality of life and more tolerable and safe pharmacological treatment for this population. Patients with mental illness are exposed to a particularly high risk of periodontal diseases because of impaired oral hygiene maintenance due to precarious fine motor skills, self-negligence associated with mental illness, inability to access dental health services and deleterious habits like smoking. Information on loss of attachment gives an estimate of the lifetime accumulated destruction of the periodontal attachment. However, studies conducted to assess periodontal status among patients with schizophrenia are scanty and none till date to assess the loss of attachment (Eltas et al., 2013; Nielsen et al., 2011; Yousef, 2014; Chu et al., 2010; Janardhanan et al., 2011; Tani et al., 2012; Lisa et al., 2013). This study was carried out to evaluate association between periodontal health including loss of connective tissue attachment with schizophrenia and to estimate the associated risk factors.

2. Methodology

The target population for the eight month time based study cross-sectional study was consenting patient attending the Psychiatry Outpatient Services of All India Institute of Medical Sciences (AIIMS), Bhopal and clinically diagnosed with schizophrenia, based on ICD-10 criteria (World Health Organization, 1993). A total of 156 patients participated in the study from November 2105 to June 2015; response rate being approximately 90%. Information on demographic characteristics and the associated co-morbidities like hypertension, diabetes and cardiovascular disease was collected by means of personal interview and a questionnaire administered by the examiner. Modified Kuppuswamy's scale was used to assess the socioeconomic status of the study participants (Bairwa, Rajput, & Sachdeva, 2013). All participants enrolled in the study belonged to the same ethnicity. The dental team comprised of two trained examiners assisted by a recording clerk.

3. Dental examination

Oral examinations were conducted in Department of Dentistry, AIIMS, Bhopal. Data was collected as per WHO recommendations (WHO, 1997). Community Periodontal Index (CPI) and loss of connective tissue attachment (LOA) was used to assess the periodontal health utilizing a mouth mirror and a CPI probe. The mouth is divided into six sextants defined by tooth numbers: 18-14, 13–23, 24–28, 38-34, 33–43 and 44-48. A sextant was examined only if there are two or more teeth present and not indicated for extraction. An index tooth should be probed using the probe as a sensing instrument to determine pocket depth and to detect sub gingival calculus and bleeding response. When the probe is inserted, the ball tip should follow the anatomical configuration of the surface of the tooth root. The probe tip should be inserted gently into the gingival sulcus and total extent of the sulcus was explored. The codes used for recording CPI scores were: 0 – Healthy, 1 – Bleeding on probing, 2 – Calculus detected during probing, 3 – Pocket 4 to 5 mm, 4 – Pocket 6 mm or more. The codes used to record loss of attachment were: 0 – Loss of attachment 0 to 3 mm, 1 - Loss of attachment 4 to 5 mm, 2 - Loss of attachment 6 to 8 mm, 3 - Loss of attachment 9 to 11 mm, 4 - Loss of attachment 12 mm or more. Highest score is recorded from the index teeth in each sextant both for CPI and LOA.

A two day training session was conducted for standardization and calibration of the examiners. The Kappa statistic was performed and a score of 0.88 for inter examiner agreement was achieved. An intra-examiner agreement between 0.88 – 0.90 was acquired for the two examiners. Examination procedures were standardized for validity and reproducibility of data prior to and in between the survey.

Ethical clearance was granted by the Institutional Ethics Committee of AIIMS, Bhopal. Informed written consent from the study subjects was obtained prior to including them in the survey. Duplicate examinations were conducted systematically on approximately 10% (every ten sample) of the subjects by the two examiners throughout the survey and the kappa statistic was in range of 0.88 – 0.90.

4. Statistical analysis

Data was collected, entered and analyzed using SPSS version 21.0 (SPSS Inc., Chicago, Illinois, USA) for windows. Chi Square and Mann – Whitney *U* test were used to compare between two or more groups for categorical and quantitative variables. Logistic regression analysis was performed to determine association of independent variables with periodontal pockets and loss of connective tissue attachment. A group of independent variables comprising age, gender, socioeconomic status, tobacco consumption, admission to psychiatry facility, duration of illness and utilization of dental care were considered. Odds ratio was computed for the study variables with 95% confidence interval. Dependent variables being introduced for regression analysis were dichotomized. Significance was set at ≤ 0.05.

5. Results

Overall, 156 participants comprised the study sample; 99 (63.5%) male and 57 (35.5%) females. Twenty three (23.2%) male workers were illiterate as compared to 18 (31.5%) female workers who had not received any level of formal education. Annual income noted among 71 (71.7%) male and 55 (96.4%) female participants was $\leq$ 1000 US $. A total of 23 (14.7%), 71 (45.5%) and 62 (39.7%) study participants were from the high, middle and low socioeconomic status ($p \leq 0.001$). No significant gender differences were noted for age, literacy and annual income levels among study participants (Table 1).

Only, 15 (9.6%) research participants brushed two or more times a day, with significant gender differences being observed ($p \leq 0.05$). Tobacco use was recorded among 81 (51.9%) study subjects, 77 (79.3%) male and 4 (69.1%) female participants ($p \leq 0.001$; Table 2). A total of 142 (91%) research participants, 79 (65.5%) male and 42 (76.2%) females had never visit a dentist ($p \leq 0.05$). Admission to psychiatry facility was noted among 29 (18.6%) study subjects, 21 (21.2%) male and 8 (14%) female participants ($p \leq 0.001$; Table 2). No significant gender differences were noted between mode, material used for cleaning teeth, type of medication used, duration of illness and the associated co-morbidities (Table 2).

Bleeding gums, calculus and periodontal pockets were noted among 154 (98.8%) study participants. Highest CPI score of 1 (bleeding), 2 (calculus), 3 (shallow pockets of 4 to 5 mm) and 4 (deep pockets $\geq$ 6 mm) were noted among 11 (7.1%), 34 (21.9%), 72 (46.1) and 37 (23.7%) study participants respectively. These were determined as worst findings. Significant association was noted between community periodontal index scores (bleeding, calculus, shallow and deep pockets) with age, gender, socioeconomic status, frequency of cleaning teeth,

Table 1
Demographic characteristics of study population.

Age group (years)	Gender		P value
	Male (%)	Female (%)	
18-34 years	37 (37.4)	23 (40.4)	0.33
35-44 years	35 (35.3)	21 (36.8)	
45-60 years	27 (27.3)	13 (22.8)	
Total	99 (100)	57 (100)	
Literacy status Male (%) **Female** (%) **P value**			
Illiterate	23 (23.2)	18 (31.5)	0.60
Completed high school (12th Grade)	26 (26.3)	21 (36.8)	
Graduation and higher	50 (50.5)	18 (31.7)	
Total	99 (100)	57 (100)	
Annual Income levels (Rs) * Male (%) **Female** (%) **P value**			
> 0 ≤ 65,000 (~1000 US $)	71 (71.7)	55 (96.5)	0.24
> 65,000 ≤ 260,000 (~1000 to 4000 US $)	28 (28.3)	02 (3.5)	
Total	99 (100)	57 (100)	
Socioeconomic status (SES)	**Male** (%)	**Female** (%)	**P value**
High SES	19 (19.2)	04 (7)	0.001
Middle SES	41 (41.4)	30 (52.7)	
Low SES	40 (40.4)	22 (38.6)	
Total	99 (100)	57 (100)	

*1 US $ = ~ Rs 65,000; SES based on Modified Kuppuswamy's Socioeconomic Scale.

Table 2
Oral health behavioral characteristics of study population.

Oral health related behavior variables		Gender		P Value
		Male N (%)	Female N (%)	
Mode of cleaning teeth	Finger	5 (5)	7 (12.3)	0.94
	Toothbrush	94 (95)	50 (87.7)	
Frequency of cleaning teeth	Once daily	90 (90.9)	51 (89.5)	0.05
	≥ 2 times a day	9 (9.1)	06 (10.5)	
Material used for cleaning teeth	Toothpaste	93 (93.9)	52 (91.2)	0.67
	Toothpowder	06 (6.1)	05 (8.8)	
Tobacco related habits	Absent	22 (22.2)	53 (93)	0.001
	Present	77 (77.8)	04 (07)	
Utilization of dental care	Never visited	79 (79.8)	42 (73.7)	0.05
	≤ 1 year back	2 (2)	5 (8.8)	
	> 1 year back	18 (18.2)	10 (17.5)	
Admission to psychiatric facility	Yes	21 (21.2)	08 (14)	0.001
	No	78 (78.8)	49 (86)	
Duration of study illness	≥ 10 years	58 (58.6)	33 (57.9)	0.27
	< 10 years	41 (41.4)	24 (42.1)	
Type of medication	Atypical & Typical	12 (12.1)	10 (17.5)	0.64
	Atypical	87 (87.9)	47 (82.5)	
Co-morbidities	Absent	69 (69.7)	40 (70.1)	0.23
	Present	30 (30.3)	17 (29.9)	

tobacco consumption, utilization of dental care and admission to psychiatric facility ($p \leq 0.001$; Table 3). Among the three age groups of 18–34 years, 35–44 years and 45 to 60 years, periodontal pockets were noted in 33 (55%), 41 (73.2%) and 35 (87.5%) subjects respectively ($p \leq 0.001$; Table 3). Periodontal pockets were noted among 74 (74.7%) male and 35 (61.4%) female study participants ($p \leq 0.001$). Ten (43.4%), 43 (60.5%) and 56 (90.3%) participants from high middle and low socioeconomic status had periodontal pockets ($p \leq 0.001$). Seven subjects (46.6%) brushing two or more times a day had periodontal pockets as compared to 102 (72.3%) subjects brushing once daily ($p \leq 0.001$). Seventy one (87.6%) and 38 (50.6%) study subjects with and without tobacco related habits had periodontal pockets ($p \leq 0.001$). Ninety five (78.5%) study subjects who had never visited a dentist had periodontal pockets in contrast to those who utilized dental services ($p \leq 0.001$). Twenty six (89.6%) study participants who had been admitted to psychiatry facility had periodontal pockets ($p \leq 0.001$). Eighty (51.2%) study subjects with ten or more years of illness had periodontal pockets ($p \leq 0.001$). Thirty seven (87.3%) study participants with co-morbidities had loss of connective tissue attachment ($p \leq 0.001$; Table 3).

Loss of connective tissue attachment (LOA) was noted among 89 (57%) study participants. LOA scores of 1 (4–5 mm), 2 (6–8 mm), 3 (9–12 mm) and 4 (≥ 12 mm) were noted among 38 (24.4%), 29 (18.6%), 12 (7.7%) and 10 (6.4%) study participants respectively. Significant association was also observed for loss of attachment with age, gender, socioeconomic status, frequency of cleaning teeth, tobacco consumption, utilization of dental care and admission to psychiatric facility ($p \leq 0.001$; Table 4). Among the three age groups of 18–34 years, 35–44 years and 45 to 60 years, loss of attachment was noted in 25 (41.7%), 33 (58.9%) and 31 (77.5%) subjects respectively ($p \leq 0.001$; Table 4). Attachment loss was noted among 61 (61.6%) male and 28 (49.1%) female study participants ($p \leq 0.001$). Eight (34.7%), 35 (49.3%) and 46 (74.2%) participants from high middle and low socioeconomic status had loss of connective tissue attachment ($p \leq 0.001$). Six subjects (40%) brushing two or more times a day had attachment loss in contrast to 83 (58.9%) subjects brushing once daily ($p \leq 0.001$). Fifty seven (70.4%) and 32 (42.7%) study subjects with and without tobacco related habits had attachment loss ($p \leq 0.001$). Sixty nine (57%) study subjects who had never visited a dentist, had loss of attachment as compared to those who utilized dental services ($p \leq 0.001$).Twenty six (89.6%) study participants who had been to psychiatry facility had loss of attachment ($p \leq 0.001$).). Sixty six (42.3%) study subjects with ten or more years of illness had loss of attachment ($p \leq 0.001$). Thirty eight (80.8%) study participants with co-morbidities had periodontal pockets ($p \leq 0.001$; Table 4).

Significant gender differences were noted within age groups of 18–34 years ($p \leq 0.001$) 35–44 years ($p \leq 0.001$) and 45–60 years ($p \leq 0.001$) for mean CPI scores and loss of connective tissue attachment scores (Table 5). Mean number of sextants with periodontal pockets were 2.76 ± 0.39 and 1.98 ± 0.45 among male and female study participants ($p \leq 0.001$; Table 5). Similarly, mean number of sextants with attachment loss among male and female study participants were 1.47 ± 0.43 and 0.87 ± 0.37 respectively ($p \leq 0.001$; Table 5).

Logistic regression analysis was operated for periodontal pockets and loss of attachment as dependent variables with age, gender, socioeconomic status, frequency of cleaning teeth, tobacco consumption, utilization of dental care and admission to psychiatric facility as independent variables. The association between age, gender, socioeconomic status, tobacco consumption, utilization of dental care, admission to psychiatric facility, duration of illness and associated co-morbidities was evident with periodontal pockets with an odds ratio of 4.51 ($p \leq 0.001$), 3.18 ($p \leq 0.001$), 5.74 ($p \leq 0.001$), 4.72($p \leq 0.001$), 3.52 ($p \leq 0.001$), 4.8 ($p \leq 0.001$) 6.41 ($p \leq 0.001$) and 5.13 ($p \leq 0.001$) respectively (Table 6). Similarly, loss of connective tissue attachment was associated with odds ratio of 3.27 ($p \leq 0.001$), 6.83 ($p \leq 0.001$), 4.73 ($p \leq 0.001$), 4.27 ($p \leq 0.001$), 6.27 ($p \leq 0.001$) and 6.43 ($p \leq 0.001$) respectively with age, socioeconomic status, tobacco consumption, admission to psychiatric facility, duration of illness and associated co-morbidities (Table 6).

6. Discussion

Majority of the study participants were from middle and low socio economic groups. The study population had disproportionately high levels of periodontal disease. Levels of periodontal disease were greatest in those aged between 45 and 60 years. Only, two (1.2%) study participants had healthy gums, similar results of 1% subjects with healthy gums being reported in a study conducted by Wey, Loh, Doss, Abu Bakar, and Kisely, (2016) in Malaysia.

High tobacco consumption among 81 (51.9%) subjects and low utilization of dental care was noted, where 121 (77.6%) participants had never visited a dentist. Significant gender differences were

Table 3
Association between Community Periodontal Index scores (CPI) and known risk variables among study subjects.

Determinants	Absent (CPI = 0)	Bleeding (CPI = 1)	Calculus (CPI = 2)	Shallow Pockets (CPI = 3; 4 to 5 mm)	Deep Pockets (CPI = 4; ≥ 6 mm)	Total (n = 156)	P value
Age Range							
18-34	2 (3.3)	9 (15)	16 (26.7)	21 (35)	12 (20)	60 (100)	0.001
35-44	0 (0)	02 (3.6)	13 (23.2)	23 (41)	18 (32.2)	56 (100)	
45-60	0 (0)	0 (0)	05 (12.5)	28 (70)	7 (17.5)	40 (100)	
Gender							
Male	0 (0)	8 (8.1)	23 (23.2)	51 (51.5)	23 (23.2)	99 (100)	0.001
Female	2 (3.5)	3 (5.3)	11 (19.3)	21 (36.8)	14 (24.6)	57 (100)	
Socio economic status							
High	1 (4.3)	5 (21.7)	7 (30.4)	8 (34.8)	2 (8.7)	23 (100)	0.001
Middle	1 (1.4)	5 (7)	22 (31)	29 (40.8)	14 (19.7)	71 (100)	
Low	0 (0)	1 (1.56)	5 (7.9)	35 (55.6)	21 (33.4)	62 (100)	
Frequency of cleaning teeth							
Once daily	0 (0)	8 (5.6)	31 (22)	66 (46.8)	36 (25.6)	141 (100)	0.001
≥ 2 times	2 (13.3)	3 (20)	3 (20)	6 (40)	1 (6.7)	15 (100)	
Tobacco consumption							
Yes	0 (0)	3 (3.7)	7 (8.7)	48 (59.2)	23 (28.4)	81 (100)	0.001
No	2 (2.6)	8 (10.7)	27 (36)	24 (32)	14 18.7)	75 (100)	
Utilization of dental care							
Never	0 (0)	0 (0)	26 (21.5)	59 (48.7)	36 (29.8)	121 (100)	0.001
≤ 1 year back	1 (14.3)	5 (71.4)	1 (14.3)	0(0)	0 (0)	7 (100)	
≥ 1 year back	1 (3.6)	6 (21.4)	7 (25)	13 (46.4)	1 (3.6)	28 (100)	
Admission to psychiatry facility							
Yes	0 (0)	0 (0)	3 (10.3)	16 (55.1)	10 (34.6)	29 (100)	0.001
No	2 (1.6)	11 (8.7)	31 (24.4)	56 (44)	27 (21.3)	127 (100)	
Duration of illness							
< 10 years	2 (3.1)	9 (13.8)	25 (38.5)	18 (27.7)	11 (16.9)	65 (100)	0.001
≥ 10 years	0 (0)	2 (2.2)	9 (9.9)	54 (59.3)	26 (28.6)	91 (100)	
Co-morbidities							
Present	0 (0)	3 (6.4)	6 (12.8)	23 (48.9)	15 (31.9)	47 (100)	0.001
Absent	2 (1.8)	8 (7.3)	28 (25.7)	49 (45)	22 (20.2)	109 (100)	

Table 4
Association between Loss of Attachment scores (LOA) and known risk variables among study subjects.

Determinants	LOA = 0-3 mm (LOA = 0)	LOA = 4-5 mm (LOA = 1)	LOA = 6-8 mm (LOA = 2)	LOA = 9-12 mm (LOA = 3)	LOA = ≥ 12 mm (LOA = 4)	Total (N = 156)	p Value
Age Range							
18-34	35 (58.3)	11 (18.3)	8 (13.3)	4 (6.7)	2 (3.4)	60 (100)	0.001
35-44	23 (41)	15 (26.7)	9 (16.1)	5 (8.9)	4 (7.1)	56 (100)	
45-60	9 (22.5)	12 (30)	12 (30)	3 (7.5)	4 (10)	40 (100)	
Gender							
Male	38 (38.4)	24 (24.2)	21 (21.2)	9 (9.1)	7 (7.1)	99 (100)	0.001
Female	29 (50.8)	14 (24.6)	8 (14)	3 (5.2)	3 (5.2)	57 (100)	
Socio economic status							
High	15 (65.2)	6 (26)	1 (4.3)	1 (4.3)	0 (0)	23 (100)	0.001
Middle	36 (50.7)	18 (25.4)	10 (14.1)	4 (5.6)	3 (4.2)	71 (100)	
Low	16 (25.8)	14 (22.6)	18 (29)	7 (11.3)	7 (11.3)	62 (100)	
Frequency of cleaning teeth							
Once daily	58 (0)	33 (5.8)	28 (22.3)	12 (47.4)	10 (24.5)	141 (100)	0.001
≥ 2 times	9 (11.7)	5 (17.6)	1 (17.6)	0 (35.2)	0 (17.6)	15 (100)	
Tobacco consumption							
Yes	24 (29.6)	25 (30.9)	19 (23.4)	7 (8.6)	6 (7.5)	81 (100)	0.001
No	43 (57.3)	13 (17.3)	10 (13.4)	5 (6.7)	4 (5.3)	75 (100)	
Utilization of dental care							
Never	52 (43)	29 (24)	23 (19)	9 (7.4)	8 (6.6)	121 (100)	0.001
≤ 1 year back	5 (71.4)	1 (14.3)	1 (14.3)	0(0)	0 (0)	7 (100)	
≥ 1 year back	10 (35.7)	8 (28.6)	5 (17.8)	3 (10.7)	2 (7.1)	28 (100)	
Admission to psychiatry facility							
Yes	3 (10.3)	13 (44.9)	5 (17.2)	4 (13.8)	4 (13.8)	29 (100)	0.001
No	64 (50.4)	25 (19.7)	24 (18.9)	8 (6.3)	6 (4.7)	127 (100)	
Duration of illness							
< 10 years	42 (3.1)	11 (13.8)	8 (38.5)	2 (27.7)	2 (16.9)	65 (100)	0.001
≥ 10 years	25 (0)	27 (2.2)	21 (9.9)	10 (59.3)	8 (28.6)	91 (100)	
Co-morbidities							
Present	6 (12.7)	14 (29.8)	11(23.4)	4 (8.5)	8 (17)	47 (100)	0.001
Absent	61 (56)	24 (22)	18 (16.5)	8 (7.3)	2 (1.8)	109 (100)	

Table 5
Age wise distribution of mean CPI and LOA scores.

Age group (years)	Gender		p Value	Total
	Male (%)	Female (%)		
Mean CPI				
18-34 years	2.66 ± 0.31	1.72 ± 0.71	0.001	2.19 ± 0.51
35-44 years	2.89 ± 0.53	1.91 ± 0.43	0.001	2.4 ± 0.48
45-60 years	2.74 ± 0.32	2.31 ± 0.22	0.001	2.53 ± 0.27
Total	2.76 ± 0.39	1.98 ± 0.45	0.001	2.37 ± 0.42
Mean LOA				
18-34 years	0.87 ± 0.20	0.31 ± 0.11	0.001	0.59 ± 0.16
35-44 years	1.66 ± 0.41	0.89 ± 0.46	0.001	1.27 ± 0.43
45-60 years	1.90 ± 0.68	1.42 ± 0.53	0.001	1.66 ± 60
Total	1.47 ± 0.43	0.87 ± 0.37	0.001	1.17 ± 0.4

Table 6
Logistic Regression analysis with periodontal pockets and loss or attachment as dependent variable.

Periodontal pocket as dependant variable (CPI ≤ 2 vs CPI ≥ 3)				
Variables	B	SE B	P	OR (95%CI)
Age	1.31	0.76	0.001	4.51 (1.05, 18.3)
Gender	0.62	0.49	0.001	3.18 (1.24, 4.23)
Socioeconomic status	0.55	0.70	0.001	5.74 (1.09, 11.8)
Frequency of cleaning teeth	0.27	0.66	0.05	1.35 (1.01, 2.32)
Tobacco consumption	0.71	0.81	0.001	4.72 (1.25, 10.7)
Utilization of dental care	1.14	0.37	0.001	3.52 (1.31, 6.4)
Admission to psychiatric facility	1.23	0.41	0.001	4.80 (1.38,11. 1)
Duration of illness	1.27	0.33	0.001	6.41 (1.52, 21.3)
Co-morbidities	0.42	0.26	0.001	5.13 (1.06. 13.5)
Loss of attachment as dependant variable (LOA = 0 vs LOA > 0)				
Variables	B	SE B	P	OR (95%CI)
Age	0.64	0.86	0.001	3.27 (1.26, 11.7)
Gender	1.31	0.45	0.001	2.35 (1.21, 6.3)
Socioeconomic status	1.03	1.23	0.001	6.83 (1.23, 19.5)
Frequency of cleaning teeth	0.34	0.66	0.05	1.51 (1.07, 3.9)
Tobacco consumption	1.27	1.13	0.001	4.73 (1.3, 8.4)
Utilization of dental care	1.13	1.20	0.001	2.85 (1.22, 9.8)
Admission to psychiatric facility	1.66	0.71	0.001	4.27 (1.29, 20.3)
Duration of illness	1.35	0.67	0.001	6.27 (1.37, 20.3)
Co-morbidities	0.73	0.62	0.001	6.43 (1.31, 18.5)

Variables- Age: ≤ 44 and ≥ 45; Gender: Male and Female; Socioeconomic status (SES): High/Middle SES and Low SES; Frequency of cleaning teeth: Once daily and ≥ 2 times; Tobacco consumption: Present and Absent; Utilization of dental care: Utilized and Never utilized; Admission to psychiatric facility: Admitted and Never admitted; Duration of illness: < 10 years and ≥ 10 years; Co-morbidities: Present and Absent.

observed towards use of tobacco; seventy seven (77.8%) male participants in contrast to 4 (7%) female subjects ($p \leq 0.001$). Similar findings of high tobacco consumption was noted among 107 (76.5%), (70%) and 181 (32.9%) study participants in France, Turkey and Japan respectively (Bertaud-Gounot et al., 2013; Gurbuz, Alatas, Kurt, Dogan, & Issever, 2011; Tani et al., 2012). Comparable findings of low dental care utilization were also reported by studies conducted in UK and Sweden (McCreadie et al., 2004; Persson, Axtelius, Soderfeldt, & Ostman, 2009).

The use of atypical antipsychotics as line therapy for treatment of schizophrenia is based largely on their reduced risk of extra pyramidal symptoms as compared to first generation antipsychotics. However, a systematic review of comparative effectiveness of typicals versus atypicals for treating schizophrenic adults concludes an insufficient and low evidence of advantages of atypical for safety for medical events as well as their efficacy (Hartling, Abou-Setta, & Dursun, 2012). Although, with a limited number of patients on typical antipsychotics, our study did not report any difference in periodontal health between patients consuming atypical antipsychotics in comparison to those consuming both typical and atypical.

Symptoms associated with schizophrenia have a negative effect on fine motor movements and, consequently, on the patient's ability to effectively brush his/her teeth and perform oral hygiene activities. Periodontal pockets were noted among majority (69.8%) of study participants with mean CPI score of 2.37 ± 0.74, reported prevalence much higher in contrast to studies conducted in Malaysia (25.2%), Turkey (33%) and Spain (34%) (Arnaiz et al., 2011; Gurbuz et al., 2011; Wey et al., 2016). Deep periodontal pockets were reported only among 1% (11.6%) study population in Wales, in contrast to 23.7% reported in our study (Lewis, Jagger, & Treasure, 2001). Loss of connective tissue attachment (LOA) was recorded among 57% of study participants. Exceptionally high, mean LOA scores of 1.17 ± 0.4 was noted in our study. LOA scores had never been reported among patients with schizophrenia, consequently this becomes a pioneer study in this area. In contrast, to National oral health survey, periodontal scores to a large extent were extremely poor as compared to the general adult population (Bali, Mathur, & Talwar, 2004).

Increasing age, male gender, lower socioeconomic status, use of tobacco, poor utilization of dental care, admission to psychiatry facility, longer duration of illness and patients with co-morbidities like diabetes, hypertension and other cardiovascular diseases were established to have a significant association with periodontal disease and loss of attachment ($p \leq 0.001$). However, lower socioeconomic status (SES), longer duration of illness and associated co-morbidities had highest association with periodontal pockets and loss of connective tissue attachment with odds ratio of 5.74, 6.41, 5.13 and 6.83, 6.27, 6.43 respectively.

Low dental care uutilization, higher tobacco consumption has also been linked to the poorer socioeconomic backgrounds. Similarly, longer duration of illness and admission to psychiatric facility may be proxy indicator for the severity of the disease. These variables explain the poor periodontal health among patients with schizophrenia in our study. Poor oral health itself is associated with a lower quality of life (Patel & Gamboa, 2012). Ponizovsky et al. (2009) demonstrated that regular dental examinations and treatment for patients in psychiatric hospitals significantly improved the oral health of this population. These findings emphasize the need for attention to dental check-ups for patients with schizophrenia. Dental surgeons must acknowledge the potential need to amend their treatment plan because of the patient's impaired ability to think logically, the propensity for substance abuse and the local and systemic effects of the associated co-morbidities.

Psychiatric disorders are a public health problem and rising in considerable proportions. Periodontal health of these patients is usually more affected than the rest of the population, as oral care is more neglected because of reduced fine motor skills, inadequate dental care and the associated co-morbidities that relegate appropriate oral hygiene maintenance (Almomani, Brown, & Williams, 2006). Preventive dental education for this group of patients is essential. Advisable for caregivers of patients exhibiting tremors is to encourage and help the patient perform tooth brushing. Verbal instructions, demonstrations and colorful posters may be used to describe proper tooth brushing and flossing. The risk of suffering from periodontal diseases is very high, and thus it is necessary to create preventive and educational health programs for psychiatric patients.

7. Conclusion

Patients with schizophrenia had poor periodontal health and were associated with high periodontal breakdown and loss of connective tissue attachment scores. Efforts need to be focused on strengthening the evidence of its association through further studies including cohort investigations.

8. Financial disclosure

No funding received

9. Limitations

The study findings may be reflected with caution on patients with other psychiatric disorders based on the nature of study with specifically focus on patients with only schizophrenia.

10. Author contributions

Abhinav Singh was the principal investigator for the study. Bharathi Purohit contributed in designing the survey & data analysis. Pankaj Mittal conducted psychiatric assessment on patients with schizophrenia. All authors contributed to the critical interpretation of the data, revised the manuscript, and approved the final article for submission.

References

Almomani, F., Brown, C., & Williams, K. (2006). The effect of an oral health promotion program for people with psychiatric disabilities. *Psychiatric Rehabilitation Journal, 29*(4), 274–281.

Arnaiz, A., Zumárraga, M., Díez-Altuna, I., Uriarte, J., Moro, J., & Pérez-Ansorena, A. (2011). Oral health and the symptoms of schizophrenia. *Psychiatry Research, 188*(1), 24–28.

Bairwa, M., Rajput, M., & Sachdeva, S. (2013). Modified Kuppuswamy's socioeconomic scale: Social researcher should include updated income criteria, 2012. *Indian Journal of Community Medicine : Official Publication of Indian Association of Preventive & Social Medicine, 38*(3), 185–186.

Bali, K., Mathur, B., Talwar, P., et al. (2004). *National oral health survey and fluoride mapping 2002–2003 India.* New Delhi: Dental Council of India.

Bertaud-Gounot, V., Kovess-Masfety, V., Perrus, C., Trohel, G., & Richard, F. (2013). Oral health status and treatment needs among psychiatric inpatients in Rennes, France: A cross-sectional study. *BMC Psychiatry, 13*, 227.

Chu, Y., Yang, P., Chou, P., Chiu, J., & Chi, Y. (2010). Factors associated with dental caries among institutionalized residents with schizophrenia in Taiwan: A cross-sectional study. *BMC Public Health, 10*(1), 482.

Eltas, A., Kartalci, S., Eltas, S., Dündar, S., & Uslu, O. (2013). An assessment of periodontal health in patients with schizophrenia and taking antipsychotic medication. *International Journal of Dental Hygiene, 11*, 78–83.

Fleischhacker, W., Cetkovich-Bakmas, M., De Hert, M., Hennekens, C., Lambert, M., & Leucht, S. (2008). Comorbid somatic illnesses in patients with severe mental disorders: Clinical, policy, and research challenges. *The Journal of Clinical Psychiatry, 69*, 514–519.

Global Burden of Disease Study (2013). Collaborators (2015) Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: A systematic analysis for the Global Burden of Disease Study 2013. *Lancet, 386*(9995), 743–800.

Gurbuz, O., Alatas, G., Kurt, E., Dogan, F., & Issever, H. (2011). Periodontal health and treatment needs among hospitalized chronic psychiatric patients in Istanbul, Turkey. *Community Dental Health, 28*(1), 69–74.

Hartling, L., Abou-Setta, M., Dursun, S., et al. (2012). Antipsychotics in adults with schizophrenia: Comparative effectiveness of first-generation versus second-generation medications: A systematic review and meta-analysis. *Annals of Internal Medicine, 157*, 498–511.

Janardhanan, T., Cohen, C. I., Kim, S., & Rizvi, B. (2011). Dental care and associated factors among older adults with schizophrenia. *Journal of the American Dental Association, 142*, 57–65.

Khokhar, A., Clifton, A., Jones, H., & Tosh, G. (2011). Oral health advice for people with serious mental illness. *Cochrane Database Systematic Review, 9*(11) CD008802.

Lewis, S., Jagger, R., & Treasure, E. (2001). The oral health of psychiatric in-patients in South Wales. *Special Care in Dentistry : Official Publication of the American Association of Hospital Dentists, the Academy of Dentistry for the Handicapped, and the American Society for Geriatric Dentistry, 21*(5), 182–186.

Lisa, H., Lloyd, M., David, G., Jason, M., & Peter, M. (2013). Unmet dental need in community-dwelling adults with mental illness: Results from the 2007 Medical Expenditure Panel Survey. *Journal of the American Dental Association, 144*(3), e16–e23.

Loganathan, S., & Murthy, S. (2011). Living with schizophrenia in India: Gender perspectives. *Transcultural Psychiatry, 48*(5), 569–584.

McCreadie, R., Stevens, H., Henderson, J., Hall, D., McCaul, R., Filik, R., et al. (2004). The dental health of people with schizophrenia. *Acta Psychiatrica Scandinavica, 110*, 306–310.

Nielsen, J., Munk, P., Skadhede, S., & Correll, U. (2011). Determinants of poor dental care in patients with schizophrenia: A historical, prospective database study. *The Journal of Clinical Psychiatry, 72*, 140–143.

Patel, R., & Gamboa, A. (2012). Prevalence of oral diseases and oral-health-related quality of life in people with severe mental illness undertaking community-based psychiatric care. *British Dental Journal, 213*, E16.

Persson, K., Axtelius, B., Soderfeldt, B., & Ostman, M. (2009). Monitoring oral health and dental attendance in an outpatient psychiatric population. *Journal of Psychiatric and Mental Health Nursing, 16*, 263–271.

Ponizovsky, A., Zusman, S., Dekel, D., Masarwa, A., Ramon, T., Natapov, L., et al. (2009). Effect of implementing dental services in Israeli psychiatric hospitals on the oral and dental health of inpatients. *Psychiatric Services (Washington, DC), 60*, 799–803.

Tani, H., Uchida, H., Suzuki, T., et al. (2012). Dental conditions in inpatients with schizophrenia: A large-scale multi-site survey. *BMC Oral Health, 12*, 32.

Wey, C., Loh, S., Doss, G., Abu Bakar, K., & Kisely, S. (2016). The oral health of people with chronic schizophrenia: A neglected public health burden. *The Australian and New Zealand Journal of Psychiatry, 50*(7), 685–694.

WHO (1997). *Oral health surveys: Basic methods* (4th ed.). Geneva: World Health Organization.

World Health Organization (1993). *The ICD-10 classification of mental and behavioural disorders. Diagnostic criteria for research.* Geneva: World Health Organization.

Yousef, A. (2014). Risk factors of periodontal disease: Review of the literature. *International Journal of Dentistry, 2014* 182513.