Original Research Paper

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Association of Tooth Loss and Hypertension Among Middle and Older Aged Indian Population.

Abstract:

Background: The perpetuity has become a rising trend in advanced and growing countries around the globe. This phenomenon has altered several aspects of social, economic, political and biomedical dynamic. In public health, there's need to understand the challenge to society due to this multifaceted dynamics in a holistic way. High blood pressure is recognized as the most leading risk element for chronic diseases. It is considered as one of the modifiable risk factor for life threatening conditions likeheart failure, coronary artery disease, chronic renal failure and cerebrovascular disease. Apart from the properly-mounted reasons of hypertension, markers of oral inflammation, which include periodontal diseases and tooth loss are independently associated with high blood pressure. However this opinion is still not conclusive.

Objective: To find association of tooth loss and hypertension in middle and old aged population.

Methodology: A cross-sectional study was conducted among individuals who were aged above 40 years and reported to the Outpatient Department of the Kothiwal Dental College and Research Centre Moradabad. The study procedure included face to face interview using prestructured questionnaire which included demographic characteristics (age, sex, education, marital status, area of residence), socioeconomic status, health-related behaviour, periodontal status. Hypertension and diabetes were recorded as reported by the participants.

Results: Partial tooth loss was found associated with hypertension on crude comparison.24% of participants with partial tooth loss had hypertension, but after adjusting confounding variables there was no statistical significant association between partial tooth loss and hypertension(OR 0.829; 95%CI:0.348-1.586) with p- value =0.977.

Conclusion: Hypertension was higher among the participants with partial tooth loss. But there was not found independent association between tooth loss and hypertension.

Key-words: Hypertension; Tooth loss

Introduction:

Theperpetuity has become a rising trend in advanced and growing countries around the globe [1]. This phenomenon has altered several aspects of social, economic, political and biomedical dynamic [2]. In public health, there's need to understand the challenge to society due to this multifaceted dynamics in a holistic way [3]. High blood pressure is recognized as the most leading risk element for chronic diseases[4]. It is considered as one of the modifiable risk factor for life threatening conditions likeheart failure,coronary artery disease, chronic renal failure and cerebrovascular disease[5]. Apartfrom the properly-mounted reasons of hypertension, markers of oral inflammation, which include periodontal diseases and tooth loss are independently associated with high blood pressure [6-10]. Various evidence from cohort and cross-sectional studies of older people confirmed an association between disease of periodontium or tooth loss and hypertension [11,12,6,13,14]. It has been reported from the study of Desvarieux et al. a direct

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relationship has been seen between subgingival periodontal bacteria and hypertension[15]. An inverse association has been shown among men between hypertension and number of teeth by Volzke et al. 2006[16].All through the aging process, the cumulative nature of normally suggested oral diseases(dental caries and periodontitis)can promote a widespread pattern of severity that culminates in loss of tooth[6].The complications including psychosocial and physiological aspect due to loss of teeth are considered as the public health problem[6].

"The well established risk factors for blood pressure , such as obesity , lack of physical activity, smoking, low income, low education level, studies have suggested that they are also markers of oral inflammation such as periodontal diseases and tooth loss"[17]. Very few studies have focussed on the middle aged population while most of them have targeted the older population[6].The report from the study done on South African population showed that the risk indicator for Hypertension is complete edentulousness[6]. However,no strong evidence has been presented in literature to show this association. Moreover, there may be a need for research to be accomplish on middle aged population to strengthen the hypothesis of association between tooth loss and high blood pressure. For this reason, the intention of this current study was accessing the association of tooth loss and hypertension among middle and elderly aged Indian population.

Methodology:

Study design and participants:

A cross-sectional study was conducted among individuals who were aged above 40 years and reported to the Outpatient Department of the Kothiwal Dental College and Research Centre Moradabad. The minimum sample size taken was 300. Non-probability sampling was used to select the participants. The face to face interview was done using prestructured questionnaire.

On the basis of biological plausibility and by the theoretical evidence of association between tooth loss and hypertension from the previous studies, the covariates such as demographic characteristics, socioeconomic status, health-related behavior, periodontal status were considered in the study. The questionnaire included were about demographic characteristics (sex, education, area of residence,age, marital status), socioeconomic status (Kuppuswamy scale 2021) [18], health -related behaviour (type of tobacco use, alcohol intake), periodontal status(CPI). The number of missing teeth of the participants were counted including the 3rd molar. The questionnaire regarding the hypertension and diabetes was recorded as self reporting by the participants. The reliability of periodontal status measurement was assessed by using Kappa statistic by taking 10% of total sample size. (Kappa statistic = 0.83)

Inclusion criteria:

The current study included participants consisting of both men and women aged above 40 years and who have completed the questionnaire in front of the investigator.The third molar was also included in the study while counting the number of missing teeth.

Exclusion criteria:

The subject who did not give informed consent were excluded from study. The impacted teeth, the decayed teeth , congenital missing teeth were not included in the criteria for the loss of tooth in the study.

The approval of ethical committee was obtained from the Institutional Review and Ethics Committee of Kothiwal Dental college and studies Centre, Moradabad, before the commencement of study. The participants were provided information regarding study and informed verbal consent from every participant was taken with in presence of two witnesses. The participants were given a free choice to decide whether to participate or not. The research was performed in accordance with Declaration of Helsinki [19].

Sample size calculation:

The sample size was calculated based on the data driven from a pilot study with 30 participants. Assuming 95% confidence interval and, significance level α at 5%, P = 57%, Q = 43%, allowable error = 10, the final required sample size was 300, where P is the percentage of hypertensive patients.

Data management and Statistical analysis:

Statistical analyses were done using SPSS version 21 for entry of data and its analysis. Descriptive statistics such as percentage, frequency were calculated for categorical variables. Multiple logistic regression models were constructed with 95% CI and level of significance at 5% to determine any independent association between different covariates and hypertension.

Result:

A total of 300 participants from the Moradabad participated in the study and overall 39.3% of the participants had been

diagnosed with hypertension. Table 1 displayed the distribution and comparison of study subjects according to gender, age, education, demographic characteristics, socioeconomic status, periodontal status and health-related behaviour along with tooth loss and hypertension status of participants. The participants who were partially edentulous had more prevalence of hypertension (24%) than completely edentulous and dentate population.

The crude estimate from logistic regression in Model 2 showed that participants with partial tooth loss had an 2.312 times higher odds of being hypertension when compared to completely edentulous participants and this was found to be statistically significant. After adjusting for the other covariates in Model 1,there was no statistical significant association between tooth loss and hypertension. However, participants who lost 3-10 teeth had an Odds Ratio for hypertension of .829(95%CI .348-1.586)and there was not statistical significant association between partial tooth loss (3-10 loss of teeth) and hypertension. However, age, gender, smoking, periodontal status, socioeconomic status has found to be associated with hypertension after adjustment of confounding variables in logistic regression.

Hypertension was seen 2.258 times more in participants with in age group 41-55 years than older one(75 years above). Also the males have been found to have 1.930 higher odds for hypertension than females. The current study also found that subject who smoke have 2.90 higher odds for hypertension than those subjects who used to smoke in past.

Discussion:

The current study assessed the association of tooth loss with hypertension amongst middle aged and older adults in Moradabad. "Different theories have been proposed to explain the association between tooth loss and hypertension. The masticatory insufficiency due to tooth loss may alter the eating habits of individuals and thus cause less intake of vitamins, fibers and more cholesterol, consequently increases the risk of hypertension" [8,20,21,22]. Subsequently the cause of reduced fiber intake might be the partial tooth loss and this reduced fiber intake is considered as one of risk factor for hypertension. Lowe et al. supported this hypothesis by finding the effect of masticatory insufficiency due to tooth loss on hypertension [8].

The oral infection-inflammation pathway could be other possible explanation for association between tooth loss and hypertension. "As among those with some tooth loss there may still be active periodontal disease which cause chronic low grade inflammation of gingival tissue that has been linked to endothelial dysfunction. This further leads to blood pressure elevation. This possibility is further substantiated in a study by Tsakos et al. which showed association between number of periodontal pocket and hypertension prevalence" [10].

In our study after adjusting for a number of confounding variables, tooth loss and hypertension were not significantly associated, whereas other risk factors are significantly associated with hypertension. This seems that the other risk factors might have more effect on hypertension than the tooth loss. Hosadurga et al. supported our study as they also did not report any association between tooth loss and hypertension in their study [23]."Ayo-Yusuf et al. stated in their study that they did not find any significant association between partial tooth loss and hypertension" [6].

The current study results are varying from previous studies which may be due to difference in population composition. Our study population mostly belongs to low socioeconomic status and from agricultural background. These people have a strong adherence to cultural and ethnic practices like food habits. As the most of the population belonged to agricultural group, their food including mostly whole grain cereals and locally available vegetables and fruits which are rich in fibres. Moreover they can't afford and accept the luxurious diet pattern which are morerich with processed sugar and cholesterol. So the effect of masticatory insufficiency due to tooth loss on hypertension may not have played a significant role in the study population.

"Peres et al. reported a significant association between tooth loss and hypertension. Their study was conducted in a multi disciplinary population in Brazil" [11]. However the current study followed a similar protocol to above mentioned study but the results vary from their study. It could be because of the fact that the current study was conducted in a particular population in which more participants belonged from low socioeconomic status and agricultural background which might caused the variation in the result.

Periodontal disesase is the one of the main cause of tooth loss in adults as it also act as a local bacterial infection chronic in nature that may lead to endothelial dysfunction. "The link between tooth loss and risk of hypertension is chronic immune dysfunction and the oral diseases like periodontitis

lead to hyperactive immune response. The endothelial cells lining the blood vessels are the primary target of hyperactive immune response cells leading to a procoagulatory state and disturb the anti-inflammatory state. Desvarieux et al. reported positive relationship between periodontal bacterial burden and carotid intima media thickness, which is a measure of hypertension"[24]. Munoz et al. further verified this by demonstrating that periodontal pockets and hypertension are significantly associated[25].

The chronic or acute inflammatory conditions of tooth loss can also confound the results. The inflammatory condition of tooth loss which lasts for the short duration of time like acute trauma and pulpal disease leading to extraction of teeth might not lead to increase of inflammatory reactant which are responsible for hypertension as in chronic periodontal diseases. Lowe et al. supported this by finding association between tooth loss due to chronic periodontal disease and hypertension [8]. As participants reported in our study are more with partial tooth loss which might be due to inflammatory condition which lasts for only short duration of time such as trauma and pulpal disease. These condition might not lead tomore number of active pathogens in their oral cavity which may be the reason for no association between the tooth loss and hypertension in our study.

Our study results can also be due to reason the study participants might have tooth loss which have occurred with duration of more than 6 months. This was supported by Assche et al. in his study [26]. This long duration of tooth loss may also lead to absence of active pathogens in oral cavity which may play role in hypertension.

Tooth loss is an oral health related problem which is accumulated across life span and get worsens in later life. Severe periodontal disease, socioeconomic status andunhealthy lifestyle can lead to tooth loss and the same factors can lead to hypertension. As our study suggested that confounders including age, gender, smoking habits, periodontal status and socioeconomic status are associated with hypertension. As the current study also shows the prevalence of partial tooth loss is more in age group between 41-55 years old study population and the hypertension is also found more prevalent in same age group(18.3%). Also in the previous studies, it has been stated that chronic periodontal disease leads to tooth loss (Murthykumar et al. 2020) and increase of inflammatory reactants, like C- reactive protein act as potential risk factor for hypertension(Lowe et al. 2003) [27, 8].So it is possible that the tooth loss may act as risk indicator for hypertension.

Males in the age group 41-55 years with smoking habit and of lower socioeconomic status are associated with hypertension. This can be due to more stressful lifestyle of people among these age group. These people have to deal with kids, work, ageing parents and constant pull to stay connected. Also the males with in age group 41-55years old mostly reported during study, which can be one factor that these age group people found to more hypertensive than other age group people. Males are found to have higher hypertension than females. Cutler et al. also reported in his study that males are more prone for hypertension [28]. "Sandberg and Ji et al. in 2012 found this gender difference for hypertension and reported that biological factors include sex hormones, chromosomal differences and other biological sex differences that are protective against hypertension in women" [29].

The participants with smoking habit in our study has higher hypertension than those who did not smoke. This result is in agreement from a study by A. virdis et al. which demonstrated significant association between smoking and hypertension [30]. This is due to fact that nicotine in cigarettes and other tobacco products make blood vessels get narrower and raise the blood pressure. It is evident even from previous studies which were conducted on low education and low socioeconomic status people which cleared that low education lead to less knowledge about self management, improving and controlling lifestyle habits which are detrimental in nature leads to hypertension. Itamar Grotto et al. 2008 stated that lower socioeconomic status people have an association with hypertension [31]. Possible explanation for this impact include lack of awareness for hypertension prevention, control, better accessibility and adherence to medical treatment. Our study is also in agreement with the association of education and socioeconomic status with hypertension even after controlling the confounding variables. So this has been seen from the current study all the risk factors which leads to tooth loss which is evident from the previous studies, also found to be associated with hypertension, but tooth loss itself is not associated with it.

Strength of study:

The important strength of this study is that data taken from participants belonged to urban and rural area. Furthermore, the tooth loss and periodontal status was recorded quantitatively, so its severity can be assessed in the

population. In addition, all the participants were blinded to the study hypothesis. Furthermore, we have no evidence of a systematic error, because of the observed biological plausibility between hypertension and other explanatory variables.

Limitations of the study:

The current study is not free from limitations either. As the disease such as diabetes and hypertension are self reported and also this study is cross-sectionalin nature, causal interferences cannot be assessed. As this study is conducted in particular area of a state in which most of the population has low socioeconomic status, therefore the findings of the study may not be robust enough for the wider population of the country. Furthermore, there are inherent problems which has been seen like recall bias about duration of tooth loss or cause of tooth loss in people with low socioeconomic status as we encountered in our study, where oral health may not be among the top priority list in healthcare. So in this study there is no talk about for the cause and duration of tooth loss to the participants.The aim of the current study is to find the association between tooth loss and hypertension among a middle and older aged Indian adult population, which can help inperforming public health strategies.

Table 1: Prevalence of self reported Hypertension according to sample characteristics:

Characteristics	Categories	n	%	HTN (%)	p- value
Sex	Male	169	56.3	24.6	.026
	Female	131	43.7	14.7	
Age	41-55	184	61.3	18.3	.000
	56-75	80	26.7	14.3	
	75 above	36	12	6.7	
Education	No schooling	81	27	12.1	.003
	Primary completed	99	33	10.3	
	High school completed	80	26	8.6	
	Graduation and above	40	14	8.3	
Smoking	Never smoker	175	58.3	17	.014
	Ever smoker	111	37	19.3	
	Former smoker	14	4.7	3	
Alcohol intake	Non user	251	83.6	32.6	.808
	Quit alcohol	12	4	1.3	
	Current user	37	12.4	5.4	
Self reported diabetes	Yes	74	24.6	11	.286
	No	226	75.4	28.3	
Area of residence	Urban	139	46.3	13	.305
	Rural	161	53.7	26.3	
Marital status	Never married	8	2.6	0.7	.678
	Married	273	91	36.3	
	Widowed	19	6.4	2.3	
Tooth loss	0-2	93	31	10	.030
	3-10	173	57.6	24	
	>10	34	11.4	5.3	
Periodontal status	Generalized gingivitis	140	46.6	18.3	.003
	Generalized periodontitis	125	41.6	19.3	
	Healthy gingiva	35	11.8	1.7	
Socioeconomic status	Upper middle	56	18.6	10	.008
	Lower middle	184	61.3	20	
	Upper lower	60	20.1	9.3	
Hypertension	Yes	118	39.3		
	No	182	60.7		

Table 2: Multivariable logistic regression model for association of tooth loss and hypertension-

Model1(Adjusted for confounding variable)			Model 2(crudeestimate)	
	OR (95% CI)	P - value	OR (95% CI)	P- value
TOOTH LOSS				
>10	Reference	.977	Reference	.030
0-2	.731(.327-1.329)		1.231(1.002-3.141)	
3-10	.829(.348-1.586)		2.312(1.812-2.681)	
EDUCATION				
Graduation and above	Reference	.026		
No schooling	3.040(1.748 3.565)			
Primary completed	2.054(1.139 3.255)			
High school completed	1.878(1.134 3.304)			
GENDER				
Female	Reference	0.04		
Male	1.930(0.121 2.898)			
AGE(yrs)				
75 above	Reference	.007		
41-55	2.258(2.012 3.490)			
56-75	1.950(1.377 2.398)			
ALCOHOL INTAKE				
Current user	Reference	.880		
Non user	.813(.339 1.949)			
Quit alcohol	.757(.159 3.601)			
SMOKING				
Former smoker	Reference	.045		
Never smoker	1.080(1.012 2.874)			
Ever smoker	2.980(2.101 3.741)			
DIABETES				
No	Reference	.747		
Yes	0.112(.583 2.123)			
AREA OF RESIDENCE				
Rural	Reference	.198		
Urban	.672(.367 1.231)			
MARITAL STATUS				
Widow	Reference	.747		
Nevermarried	0.401(.118 3.032)			
Married	.782(.259 2.443)			
PERIODONTAL STATUS				
Healthy gingiva	Reference	.037		
Gen. gingivitis	2.251(2.018 3.012)			
Gen. periodontitis	2.272(2.112 3.121)			
SOCIOECONOMIC STATUS				
Upper lower	Reference	.019		
Upper middle	1.421(1.382 3.195)			
Lower middle	2.352(1.104 3.009)			

Conclusion:

In this study, we observed the significant association between tooth loss and hypertension on crude comparison. However, when confounding variables were adjusted, there was no significant association between tooth loss and hypertension. But the confounding variables were significantly associated with hypertension. This study illustrates that tooth loss and hypertension may not have a causal relationship but the tooth loss might act as an indicator for the hypertension.

Future scope of the study:

So for the elucidation of causal association between tooth loss and hypertension there is need for further longitudinal and prospective studies to be done.

Author's Contribution:

The other authors has made a significant contribution in critical revision of the manuscript for the key intellectual content. RS and SS has made a substantial contribution in designing of the study. SS administered data collection, analysed the data and generated the tables and figures and interpreted the results. All the other authors hasread and approved the manuscript to be published.

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Conflicts of interest-

There are no conflicts of interest.

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