

Epidemiological investigation of prevalence and severity of non-carious cervical lesions in the state of Manipur- A cross sectional study

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Citation of this Article: Dr. Amandeep Kaur, Dr. Divya Jyoti, Dr. Shanteri Nayak, Dr. T Prem Lata Devi, Dr. Deepak B.S., “Epidemiological investigation of prevalence and severity of non-carious cervical lesions in the state of Manipur- A cross sectional study”, IJDSIR- February – 2024, Volume –7, Issue - 1, P. No. 59 – 71.

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Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Epidemiological studies on the prevalence of non-carious cervical lesions (NCCLs) in diverse geographical locations is imperative to gauge the real disease burden of the region.

Aims and objectives: The aim of the present study was to determine the prevalence and severity of NCCLs in the state of Manipur

Materials and Methods: 332 healthy subjects of either gender between 12-60 years of age were screened for the presence of NCCLs. The demographic details were noted. Tooth/arch wise distribution of NCCL was recorded. Severity of the lesion was recorded according

to Smith and Knight Tooth wear index. Data was analysed.

Results: Among the study participants, 91(60.3%) males as compared to 60 (39.7%) females had NCCL. Premolars were the most affected teeth by NCCL. Tooth wear index Score 2 was the most prevalent score for all the teeth.

Conclusion: Highest frequency of NCCLs was observed in the premolar teeth.

Keywords: Abfraction, Abrasion, Erosion, Non-carious cervical lesion

Key Message: NCCLs should be recognized as an etiology for tooth destruction. The public should be

educated regarding their multifactorial causes and prevention. The treating clinicians should also be sensitized to recognize this pathological entity at an early stage to avoid aesthetic disfigurement and discomfort to the patient.

Introduction

The loss of tooth structure occurring in the absence of caries at the cemento- enamel junction (CEJ) is termed as non-carious cervical lesion (NCCL) ^[1,2]. These lesions are known to have an underlying multifactorial etiology ^[3]. Most frequent location of occurrence is supragingival, more on the buccal aspect, seldom on the lingual and rarely on proximal surfaces of teeth in either arch ^[4]. Plaque retention, sensitivity, esthetic disfigurement and increased caries incidence occur as a sequelae which in turn can jeopardize pulp vitality and structural integrity of the tooth involved. Marzouk MA et al concluded that 25% of the pathological destruction of hard tissue of the tooth could be attributed to the non-carious processes ^[5]. Shulman and Robinson reported the prevalence of NCCL to be as low as 2%, whereas Bergstrom and Eliasson recorded an occurrence of 90% ^[6,7]. In an extensive review by Levitch LC et al, a prevalence of 5-85 % was reported ^[8]. The broad range suggests the variations in the criteria for defining NCCLs.

Studies on the prevalence of caries and periodontal disease have made significant contributions to the understanding of their etiology, clinical presentation and management. Epidemiological studies on the prevalence of NCCLs are limited. However, such data is essential because apart from underlining the severity and extent of the problem, they can also point to specific causal agents influencing their occurrence. By comparing different populations, valuable data can be obtained on the etiology of the lesions, as each population carries its own

characteristics. Till date there is no reported data on NCCLs in the state of Manipur. Hence, this study was conducted to determine the same. The current article is written according to STROBE guidelines.

Materials and Methodology

Subjects: A cross-sectional study was conducted over a period of six months on 332 healthy subjects of either gender between 12-60 years of age after obtaining institutional ethical clearance [Ref no.: A/206/REB/Prop(Faculty)137/64/2020]. The patients were selected by convenience sampling method who reported for dental examination and treatment in the outpatient department. Fully erupted permanent teeth with the presence of NCCLs were recruited. Cervically restored teeth, teeth with cervical defects, non-vital teeth, patients undergoing active orthodontic treatment and patients with severe periodontitis and poor oral hygiene were excluded from the study. The study procedures were conducted in complete accordance with the World Medical Association's Declaration of Helsinki.

Questionnaire

A questionnaire was developed in English language and was translated into the regional language based on epidemiological studies conducted previously. The questions pertained to demographic details, dietary habits, medication, oral health measures, lifestyle and habits. The reliability of the questionnaire was tested on a selected preliminary small sample of subjects that was retested after distinctive time period of two weeks. Correlation coefficient was 0.86 which is considered good.

Clinical examination

Prior to the commencement of the study, the researchers were trained and standardized by using models and photographs depicting the possible range of

observations. Method of detecting NCCLs was demonstrated on several subjects in the outpatient department (OPD) for a period of one week. In order to calibrate the investigators, ten subjects selected from the OPD were examined by the researchers separately. Intra-examiner agreement was calculated using Kappa statistics following WHO recommendations for validity and reliability. Cohen's Kappa value was 0.92 which is considered excellent. All the recording sheets were checked by a senior independent expert and if there were any differences they were explained and sorted out. Verbal information regarding the study was provided to the subjects willing to participate and meeting the inclusion criteria. All related queries were explained to their complete satisfaction. Written informed consent was obtained. In case of subject < 18 year of age, informed assent was obtained. Before starting the examination, the participants were asked to rinse their mouth with water and were made to sit comfortably on the dental chair. The oral cavity was divided into four quadrants: maxillary right / left and mandibular right / left. Buccal surface of all the teeth were examined for the presence of NCCLs with a mouth mirror and a William's graduated periodontal probe. When the probe was retained by some irregularity, it was considered a non-carious cervical lesion. The number of NCCLs, their tooth wise/ arch wise distribution, age and gender of the subjects was recorded.

To determine the severity of the lesions, the tooth was isolated and dried with cotton rolls. The depth of the detected NCCLs was measured by inserting the probe perpendicular to the tooth surface to the bottom of the lesion. The measurements in millimetres were scored and recorded according to modified Smith and Knights tooth wear index (TWI) ^[13] (Table 1). In the present study, the lesions were scored according to the cervical

component of the index. Briefly, a score of 0-4 was given for each scorable tooth in each subject with score of "0" denoting "no change" in contour to a maximum score of "4" denoting a "defect >2mm or exposure of pulp". For a particular subject, the highest score was taken as the representative score. The subjects with score 1 and 2 were subjected to follow ups only at periodic intervals and proper oral hygiene maintenance instructions were given. For subjects with score 3 and 4, the teeth were restored with resin modified glass ionomer cement or root canal therapy was performed respectively. After the examination was completed, an effort was made to motivate and educate the subject on good oral hygiene practices and ill effects of tobacco related habits. A questionnaire pertaining to demographic details, dietary habits and oral hygiene was filled by the investigator to study the probable etiological factors associated with it. The data acquisition was coded and not identified by name to maintain the confidentiality of the subjects.

Statistical Analysis

Following data collection, data was coded and expressed in MS Excel worksheet (Microsoft, USA). Estimated values were expressed along with 95% confidence intervals. Data analysis was done using IBM Statistical Package for Social Sciences (Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) Discrete data was presented as frequency and percentage. For comparing categorical data, Pearson's Chi square test was performed. Univariate unconditional logistic regression was used to identify the possible etiological factors associated with the presence of NCCLs. The factors that showed significant association were then used as independent variables in multivariate logistic regression analysis. Odds ratio (OR) was used to show the strength of association and 95% confidence interval

(CI) was calculated. For analysis, p-value less than 0.05 were considered statistically significant.

Results

Table 2 shows socio-demographic characteristics of the study participants with and without NCCL. Among the study participants, 91(60.3%) males as compared to 60 (39.7%) females had NCCL but no gender wise significant difference was observed. The mean age of study participants was 44.48±8.53 years with maximum proportion of NCCL in the age group of 31-45 [107 (70.9%)] followed by 12-30 years [27 (17.9%)] and 46-60 years [17 (11.3%)] with statistically significant difference (p=0.030). Higher number of participants having college education had NCCL as compared to school educated with statistically significant difference (p=0.027). Place of residence did not show any significant difference in occurrence of NCCL. The occurrence of NCCL and intensity of tooth brushing (0.003), duration of toothbrush use (p=0.025) and frequency of brushing (p=0.003) showed statistically significant difference.

Table 3 shows that left first maxillary premolars [151 (45.2%)] and first mandibular premolars [151 (45.2%)] were the most affected followed by left maxillary second premolar [142(42.5%)] and left mandibular second premolar [151 (45.2%)]. It was observed that maxillary

left central incisor [126(37.7%)], maxillary right lateral incisor [133 (38.6%)] and maxillary left canine [149 (44.6%)] were most affected among the respective tooth type.

Table 4 shows distribution on Tooth Wear Index (TWI) scores according to its position in the arch. Score 2 was the most prevalent score for all the teeth. Central incisors, canines and second molars were affected more in maxillary arch while lateral incisors, both premolars and first and third molars were affected more in mandibular arch. Left side was affected predominantly in both the arches and only maxillary and mandibular lateral incisors, mandibular canines, mandibular first molars, maxillary second molars and third molars in both the arches were affected more on right side.

The results of univariate unconditional logistic regression (Table 5) showed a direct link between the presence of multiple NCCLs and gender (p=0.041), age (p<0.001), hardness of toothbrush (p=0.001), duration of toothbrush use (p=0.008) and frequency of brushing (p=0.009).

The multivariate logistic regression analysis revealed that only age (p<0.001), hardness of toothbrush (p=0.001) and frequency of tooth brushing (p<0.001) were associated with the presence of multiple NCCLs (Table 6).

Table 1: Modified Smith and Knight’s Tooth Wear Index (TWI) for cervical surfaces

TWI	
0	No change in contour
1	Minimal loss of contour
2	Defect < 1mm deep
3	Defect 1-2mm deep
4	Defect >2mm deep, or pulp exposure or exposure of secondary dentine

Table 1^[9]

Table 2: Socio-demographic characteristics of the study participants with and without NCCL:

Variable		NCCL		Without NCCL		P value
		n	%	n	%	
Gender	Male	91	60.3%	101	55.2%	0.206 NS
	Female	60	39.7%	82	44.8%	
Age in years	12-30	27	17.9%	53	29.0%	0.030*
	31-45	107	70.9%	105	57.4%	
	46-60	17	11.3%	25	13.6%	
Education	School	70	46.4%	107	58.5%	0.027*
	College	81	53.6%	76	41.5%	
Place of living	Urban	81	53.6%	96	52.5%	0.458 NS
	Rural	70	46.4%	87	47.5%	
Intensity of tooth brushing	Mild	57	37.7%	101	55.2%	0.003*
	Moderate	74	49%	70	38.3%	
	Hard	20	13.2%	12	6.5%	
Hardness of toothbrush	Soft	50	33.1%	50	27.3%	0.491 NS
	Medium	77	51%	99	54.1%	
	Hard	24	15.9%	34	18.6%	
Duration of toothbrush use (months)	1-2	60	39.7%	100	54.7%	0.025*
	3-4	67	44.4%	61	33.3%	
	5-6	24	15.9%	22	12.0%	
Frequency of brushing (per day)	Once	54	35.8%	99	54.1%	0.003*
	Twice	65	43%	54	29.5%	
	Thrice	32	21.2%	30	16.4%	

Table 3: Distribution of NCCLs according to its position in the arch:

Tooth type	Presence of NCCL							
	Maxillary				Mandibular			
	Right		Left		Left		Right	
	n	%	n	%	n	%	n	%
Central incisor	124	37.1%	126	37.7%	118	35.3%	103	30.8%
Lateral incisor	133	39.8%	85	25.4%	103	30.8%	132	39.5%
Canine	131	39.2%	149	44.6%	120	35.9%	132	39.5%
First premolar	133	39.8%	151	45.2%	151	45.2%	151	45.2%
Second premolar	126	37.7%	142	42.5%	151	45.2%	121	36.2%

First molar	124	37.1%	135	40.4%	138	41.3%	105	31.4%
Second molar	136	40.7%	124	37.1%	134	40.1%	136	40.7%

Table 4: Distribution on Tooth Wear Index (TWI) scores according to its position in the arch:

Tooth type	TWI scores		Presence of NCCL			
			Maxillary		Mandibular	
			Right	Left	Left	Right
Central incisor	0	n	210	208	216	231
		%	62.9%	62.3%	64.7%	69.2%
	1	n	61	42	36	50
		%	18.3%	12.6%	10.8%	15.0%
	2	n	63	72	76	53
		%	18.9%	21.6%	22.8%	15.9%
	3	n	0	12	6	0
		%	0.0%	3.6%	1.8%	0.0%
	4	n	0	0	0	0
		%	0.0%	0.0%	0.0%	0.0%
	R	n	0	0	0	0
		%	0.0%	0.0%	0.0%	0.0%
Lateral incisor	0	n	201	249	231	202
		%	60.2%	74.6%	69.2%	60.5%
	1	n	61	20	34	41
		%	18.3%	6.0%	10.2%	12.3%
	2	n	72	37	69	61
		%	21.6%	11.1%	20.7%	18.3%
	3	n	0	28	0	30
		%	0.0%	8.4%	0.0%	9.0%
	4	n	0	0	0	0
		%	0.0%	0.0%	0.0%	0.0%
	R	n	0	0	0	0
		%	0.0%	0.0%	0.0%	0.0%
Canine	0	n	203	185	214	202
		%	60.8%	55.4%	64.1%	60.5%
	1	n	52	32	83	55
		%	15.6%	9.6%	24.9%	16.5%
	2	n	79	107	37	72
		%	23.6%	30.3%	10.9%	22.0%

	3	%	23.7%	32%	11.1%	21.6%	
		n	0	10	0	5	
	4	%	0.0%	3.0%	0.0%	1.5%	
		n	0	0	0	0	
	R	%	0.0%	0.0%	0.0%	0.0%	
		n	0	0	0	0	
First Premolar	0	%	60.2%	54.8%	54.8%	54.8%	
		n	201	183	183	183	
	1	%	7.8%	21.3%	13.2%	12.0%	
		n	26	71	44	40	
	2	%	23.7%	16.8%	25.4%	15.6%	
		n	79	56	85	52	
	3	%	7.5%	7.2%	6.6%	12.9%	
		n	25	24	22	43	
	4	%	0.9%	0.0%	0.0%	0.0%	
		n	3	0	0	0	
	R	%	0%	0%	0.0%	4.8%	
		n	0	0	0	16	
	Second Premolar	0	%	62.3%	57.5%	59.9%	59.3%
			n	208	192	200	198
1		%	6.6%	3.9%	3.0%	11.1%	
		n	22	13	10	37	
2		%	15.3%	24.0%	18.6%	23.4%	
		n	51	80	62	78	
3		%	15.9%	14.7%	18.6%	6.3%	
		n	53	49	62	21	
4		%	0.0%	0.0%	0.0%	0.0%	
		n	0	0	0	0	
R		%	0.0%	0.0%	0.0%	0.0%	
		n	0	0	0	0	
First molar		0	%	62.9%	59.6%	54.8%	63.8%
			n	210	199	183	213
	1	%	8.1%	8.1%	10.5%	5.1%	
		n	27	27	35	17	

	2	n	57	51	58	79	
		%	17.1%	15.3%	17.4%	23.7%	
	3	n	40	57	58	25	
		%	12.0%	17.1%	17.4%	7.5%	
	4	n	0	0	0	0	
		%	0.0%	0.0%	0.0%	0.0%	
	R	n	0	0	0	0	
		%	0.0%	0.0%	0.0%	0.0%	
	Second molar	0	n	198	210	196	229
			%	59.3%	62.9%	58.7%	68.6%
		1	n	38	68	30	47
			%	11.4%	20.4%	9.0%	14.1%
2		n	58	30	63	12	
		%	17.4%	9.0%	18.9%	3.6%	
3		n	37	24	40	38	
		%	11.1%	7.2%	12%	11.3%	
4		n	0	0	0	0	
		%	0.0%	0.0%	0.0%	0.0%	
R		n	3	2	5	8	
		%	0.9%	0.6%	1.5%	2.4%	

Table 5: Univariate analysis of the association between patient-related risk factors and non-carious cervical lesions:

Variable		OR	95% CI	p value
Gender	Male	1		
	Female	0.732	0.39-1.07	0.041*
Age	12-30	1		
	31-45	1.253	0.73-1.66	0.021*
	46-60	6.821	4.41-8.77	<0.001*
Intensity of tooth brushing	Mild	1		
	Moderate	0.831	0.48-1.24	0.068
	Hard	1.230	0.74-1.59	0.052
Hardness of toothbrush	Soft	1		
	Medium	1.425	0.86-2.33	0.003*
	Hard	2.311	1.41-2.86	0.001*
Duration of toothbrush use (months)	1-2	1		
	3-4	0.543	0.31-0.79	0.012*

	5-6	0.436	0.16-0.53	0.008*
Frequency of brushing (per day)	Once	1		
	Twice	0.489	0.23-0.76	0.010*
	Thrice	0.332	0.11-0.51	0.009*

Table 6: Multivariate analysis of the association between patient-related risk factors and non-carious cervical lesions:

Variable		OR	95% CI	p value
Gender	Male	1		
	Female	1.097	0.75-1.82	0.632
Age	12-30	1		
	31-46	2.689	1.34-3.28	0.011*
	46-60	4.365	2.98-5.71	<0.001*
Hardness of toothbrush	Soft	1		
	Medium	0.984	0.86-2.33	0.003*
	Hard	2.311	1.41-2.86	0.001*
Duration of toothbrush use (months)	1-2	1		
	3-4	0.784	0.43-1.24	0.645
	5-6	0.622	0.25-1.18	0.738
Frequency of brushing (per day)	Once	1		
	Twice	1.354	0.87-1.81	0.002*
	Thrice	2.465	1.46-2.85	<0.001*

Discussion

Inception of this study was based on the clinical experience of the investigators. An average of 10-15 patients/day with non-carious cervical lesions (NCCLs) were encountered in the outpatient department. Due to the perceived high incidence and the lack of documented indigenous data the present community based observational study was designed. The objective was to know the actual disease burden in the representative population. Various tooth wear indices have been used previously for clinical and laboratory studies [10-16]. The earliest index was documented by Broca (1879) [16] for grading the horizontal or oblique patterns of occlusal wear without pre-supposing the etiology. However, the

most practical and useful index i.e. Tooth Wear Index (TWI) was proposed by Smith and Knight (1984) [13] for measuring tooth wear irrespective of the etiology. The original index is divided into the buccal, cervical, occlusal / incisal and palatal / lingual components. However, the cervical region of the tooth is a specific anatomic dental structure, and the mechanism of loss of hard tooth substances is often different from other surfaces. Hence various authors [17, 19] have modified it and used only the cervical component of the index for measuring the extent of NCCLs. In the present study the cervical component of the index only was used.

Occurrence of NCCLs increased with age and the maximum prevalence was observed in the age group of 31-45 year. This is probably because of the longer duration of the exposure of the teeth to the deleterious habits (heavy handed brushing, bruxism, consumption of high acidic food etc.) of the subjects. In addition, older populations are more likely to have gingival recession and bone loss, with more root surface and cementum exposure, increasing the risk of cervical lesions. This result was in contrast with the study conducted by Pegoraro LF et al^[17] who observed a mean of 5.61 ± 3.34 lesions per subject. The difference could be due to a small sample size (n=70) and the age group (25-45 years) observed. The occurrence of NCCLs showed a gender predilection affecting 91(60.3%) males as compared to 60 (39.7%) females. These findings are in agreement with general perception that males have heavier occlusal forces, consume more acidic liquids and do more vigorous brushing as compare to females. Smith and Robb^[18] also concluded that the prevalence of tooth wear is more in males as compared to the females.

Premolars, particularly first premolars have been observed to be the most commonly affected teeth by NCCLs^[22, 23]. Similar findings were seen in the studies conducted by W.A.J Smith et al^[21] and Y. Hirata et al^[24]. Tar CAW et al^[25] stated similar findings that premolars as a group and first premolars in particular were most likely to have cervical lesions while lateral incisors were the least affected. The data of the study revealed no arch predilection with equal number of teeth affected in the maxillary and mandibular arches. However, Tar CAW et al (2002)^[25] reported a higher incidence in the maxillary arch (65%) in comparison to the mandibular arch (35%). They further reported a higher incidence of NCCLs in the posterior teeth (70%) when compared to the anterior (30%). In this study this

comparison was not made, as in our opinion this is a flaw since the posterior teeth are more in number and hence cannot be compared.

Based on TWI, level 2 index (dentin exposed less than $1/3^{\text{rd}}$) was observed to be the predominant score and this correlated with the chief complaint of the subjects which was sensitivity. The number of teeth affected by this level of severity increased with age. This is probably due to the fact that the subjects tend to remain dentate for a longer period of time. Most of the observations in this study were done in respect to this level index as it showed the highest number of affected teeth. These findings align with J. Borcic et al^[19], W.A.J. Smith et al^[21] and Pegoraro et al^[17].

A variety of factors contribute to the occurrence of NCCLs. Gastric reflux is a medical condition in which belching occurs and gastric juices regurgitate to the mouth. Since the gastric juices are highly acidic (pH - 2.0), the enamel of teeth can be eroded^[19]. Repeated episodes of reflux of the gastric content could be a potential factor for causation of NCCLs. Bruxism is a para-functional habit that involves subconscious clenching of teeth. It is characterized by non- functional contact of the maxillary and mandibular teeth resulting in clenching or grating of teeth. It can be diurnal or nocturnal. It causes occlusal trauma, abnormal wear pattern, and abfraction which can ultimately lead to the fracture of the tooth^[26]. Tooth powders are dentifrices which are preferred in our country due to their cost effectiveness and easy availability. However, they have been shown to contain undisclosed constituents (abrasives) which can cause deleterious effects on the tooth^[27]. Use of a firm and medium to hard tooth brush and greater application of force during tooth brushing might be a contributing factor for the development and/or aggravation of NCCLs. Heavy handed prolonged

brushing with improper motion of brushing (horizontal motion) may lead to development of NCCLs [28] Consumption of predominantly non-vegetarian diet could apply more pressure while chewing and also the fact that non-vegetarian diet is more fibrous and acidic in nature. Excessive intake of large quantities of liquid acidic food (i.e. carbonated soft drinks and lemonade) which have a very low pH (2.8) and can cause softening of the enamel leading to erosion of enamel [29] which when superimposed with other deleterious habits can lead to formation of NCCLs.

This study was done with the main aim of collecting baseline data on the prevalence and severity of NCCLs. In spite of being a preliminary study with a small sample size the data of the study confirmed the observations of the guides in regard to the rising prevalence and severity of this disease entity. This justifies the origin of this study. NCCLs are fast becoming the fourth dimension of tooth destruction after caries, periodontal disease and trauma; hence the public needs to be motivated and educated about the condition and the methods of prevention like pursuing good oral hygiene practices and dietary habits. The treating dental surgeon should also be sensitized to recognize this pathological process at an early stage to prevent esthetic disfigurement and discomfort to the patient.

Further community-based studies with larger sample size should be undertaken to find out the actual burden and investigate the proposed etiological factors.

Conclusion

NCCLs should be recognized as an etiology for tooth destruction. The public should be educated regarding its multifactorial causes and prevention. The treating dental surgeon should also be sensitized to recognize this pathological entity at an early stage to avoid aesthetic disfigurement and discomfort to the patient.

Author Contributions

Dr. Amandeep Kaur: Contributed in conceptualization of the study, data curation, formal analysis, Investigation, Methodology, and in writing the original draft, writing the review & editing.

Dr. Divya Jyoti: Contributed in conceptualization of the study, data curation, formal analysis, Investigation, Methodology, and in writing the original draft, writing the review & editing.

Dr. Shanteri Nayak: Contributed in conceptualization of the study, data curation, formal analysis, Investigation, Methodology, and in writing the original draft, writing the review & editing.

Dr. T Prem Lata Devi: Contributed in conceptualization of the study, data curation, formal analysis, Investigation, Methodology, and in writing the original draft, writing the review & editing.

Dr. Deepak B.S.: Contributed in conceptualization of the study, data curation, formal analysis, Investigation, Methodology, and in writing the original draft, writing the review & editing.

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