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Worldwide Prevalence of Occupational Diseases that Affect the Oral Cavity during the last 15 years- A Systematic Review

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Abstract

Background: Exposure to physical, chemical, and biological agents at the workplace can cause a magnitude of adverse effects ranging from simple discomfort and irritation to severe conditions. This study was undertaken to determine the prevalence of different types of oral conditions such as dental caries, dental erosion, oral cancer or oral mucosal lesions, periodontal disease, bruxism and temporomandibular disorders in workers worldwide, due to occupational exposure.

Methods: A systematic review of literature was conducted to identify studies that assessed prevalence of different types of oral conditions due to occupational exposure. Selected articles included cross-sectional surveys that were published between 2007 and 2022 involving adult workers. Bibliographic search of the MEDLINE-PubMed and Google Scholar database was performed on July12, 2022. Risk of bias assessment was done using Joanna Briggs Institute checklist (2020).

Results: The systematic search resulted in 13 studies which were suitable for the present review. Twelve studies were rated as strong, whereas one study was rated as moderate. Six studies assessed periodontal diseases, four studies assessed dental caries, two studies assessed dental erosion, one study assessed TMJ disorders, and one study assessed oral mucosal lesions.

Conclusion: A definite relation was seen between certain occupations and occurrence of oral lesions. With exception of only dental caries, all other pathologies that were studied showed an increased prevalence in workers

employed in either a mining or factory setting in comparison to the general population.

Keywords: Dental Caries, Dental Erosion, Occupational Exposure, Oral Cancer, Periodontal Diseases.

Introduction

The environment is one among the many determinants of the human health. The key to man's health lies largely in his environment, and the study of disease is really the study of man and his environment. Occupational environment means the sum of external conditions and influences, which prevail at the place of work, and which have a bearing on the health of working population. The interaction of the individual with the physical, chemical, and biological agents of the workplace has great bearing on his physical and the psychological health.[1, 2]

Exposure to chemical, physical, and biological agents in the workplace can result in adverse effects on workers ranging from simple discomfort and irritation to debilitating occupational diseases. For the overall well-being of the person, dental health is as essential as total body health.[1, 3] However, research that has investigated the effects of such parameters on dental disease via detailed surveys and examined both workplace parameters and oral health behaviors is scarce.[4]

The aim of this study was to investigate the prevalence of different types of oral conditions such as dental caries, dental erosion, oral cancer or oral mucosal lesions, periodontal disease, bruxism, and temporomandibular disorders in workers worldwide, due to occupational exposure.

Methods

This review is in accordance with the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) 2020 Statement [5]. The protocol of this review has been registered with the PROSPERO database under registration number: CRD42022342398.

Literature Search and Selection criteria

A systematic review of the literature was conducted to identify studies that assessed prevalence of different types of oral conditions such as dental caries, dental erosion, oral cancer, periodontal disease, bruxism, and temporomandibular disorders in workersdue to occupational exposure. Electronic searches were conducted in PubMed/Medline, Google Scholar to identify relevant studies.

To perform the initial bibliographic search, the following MeSH descriptors and free-text words and their spelling variation limited to the [Title/Abstract] with filters: Free full text was used to ensure a comprehensive recovery of entries:

For PubMed (Table S3):

- **(**prevalence) AND (worker OR workers) AND [(tooth wear OR dental erosion) OR (dental caries OR dental decay) OR (oral cancer OR oral mucosal lesions OR oral mucosal lesion) OR (periodontal disease OR periodontal diseases) OR (teeth grinding disorder OR bruxism) OR (temporomandibular disorders)]
- (worker OR workers) AND [(teeth grinding disorder OR bruxism) OR (oral cancer OR oral mucosal lesions OR oral mucosal lesion) OR (dental caries OR dental decay) OR (dental erosion OR tooth wear) OR (periodontal disease OR periodontal diseases) OR (temporo-mandibular disorders OR temporomandibular disorders)]
- (occupational exposure) AND [(dental erosion) OR (dental caries) OR (oral cancer) OR (periodontal disease OR periodontal diseases) OR (musicians)]
- (orofacial pain) AND (musical instruments)
- (temporomandibular disorders OR tmj disorders) AND [(instruments OR wind instruments OR musical instruments) OR (vocalists or musicians)]

- To perform the initial bibliographic search, the following MeSH descriptors and free-text words and their spelling variation limited to the [allintitle] filter was used to ensure a comprehensive recovery of entries:

For Google Scholar (Table S4):

- **(**prevalence) AND (worker OR workers) AND [(dental erosion) OR (dental caries) OR (oral cancer OR oral mucosal lesions OR oral mucosal lesion) OR (periodontal disease)]
- (worker OR workers) AND [(bruxism) OR (oral cancer OR oral mucosal lesions OR oral mucosal lesion) OR (dental caries) OR (dental erosion OR tooth wear) OR (periodontal disease OR periodontal diseases) OR (temporo-mandibular disorders OR temporomandibular disorders)]
- (occupational exposure) AND [(dental erosion) OR (dental caries) OR (oral cancer OR oral mucosal lesions)]
- (temporomandibular disorders OR tmj disorders) AND [(instruments OR wind instruments OR musical instruments) OR (musicians)]

To select relevant studies, the four-step PRISMA flow diagram (Figure 1) identification, screening, eligibility and included was followed by two independent reviewers (XX and XX). Then, the full texts of the selected studies were retrieved, and two independent reviewers (XX and XX) reviewed the studies for data extraction, methodological quality assessment and analysis. All discrepancies were resolved through discussion until a consensus was reached.

Inclusion and Exclusion Process

The search was limited to studies that (1) were published between 1st January 2007 to 12th July 2022, (2) were population based or community based cross-sectional studies and narrative reviews conducted on adult (>18 years) workers to assess prevalence of dental caries, dental erosion, periodontal diseases, oral cancer or oral mucosal lesions, bruxism and TMJ disorders using relevant questionnaires, (3) conducted to assess oral health status of a population in which above conditions are assessed as per eligible indices, (4) were written in English in the electronic databases.

The following studies were excluded— (1) abstracts submitted to conferences and seminars, case–control studies, clinical trials, case report studies, cohort studies, longitudinal studies, (2) Studies not mentioning sample size and sampling technique used, (3) Studies conducted in special populations (diseased, syndromic), (4) Studies whose full text was not available. (Table S5)

The PICO (ST) strategy, namely, population, intervention, comparison, and outcomes, was used as a guide for retrieving the relevant articles for this review.

Population (P): The target of this review was adult workers above 18 years of age.

Outcome (O): Prevalence (in percentage or mean value) of dental caries, dental erosion, periodontal diseases, oral cancer or oral mucosal lesions, bruxism or tmj disorders calculated as highest score recorded in the study participants and secondary outcome being age wise and gender wise prevalence (in percentage or mean value) of the same conditions.

Study Design (S): Cross-sectional studies and narrative reviews.

Timeframe (T): Between 1st January 2007 to 12th July 2022.

Data Extraction and Data Analysis

The data was extracted and recorded using a structured data extraction form made in Covidence Systematic Review Software (2022) [6].The form includes authors, country, year of publication, language, study design, sample size and method of selection of sample, setting,

characteristics of participants, relevant outcomes such as dental caries, dental erosion, oral cancer, periodontal disease, bruxism and temporomandibular disorders, disease index/diagnostic criteria, and method of aggregation. Any disagreement between the two reviewers was resolved by discussion and consensus.The findings were then compared. However, due toinadequate data for the meta-analysis from the included studies, a descriptive report was conducted.

Quality Assessment

Two reviewers (XX and XX) independently assessed the methodological quality of each included study based on the Joanna Briggs Institute (JBI) critical appraisal tool (2020)[7] to determine the extent to which an individual study addressed the possibility of bias in its methodological design, conduct and analysis (Table 1). All discrepancies were discussed between the two reviewers until a consensus was reached.

Results

Study Selection

A total of 464 articles were identified based on the keywords and MeSH terms searched forin the MEDLINE (PubMed) and Google Scholar databases, respectively. After removing duplicates and studies marked as ineligible by automation tools, 296 articles were identified. The titles and abstracts of these articles were screened and 206 were excluded. These 90 articles were scrutinized and 77 were excluded after agreement by both reviewers (XX and XX). Eventually, 13 studies were identified to be eligible and were included in this review. No additional study was identified.

Study Characteristics

Among the 13 studies (n = 10,841), the following were found (Table 2):

-Twelve from Asia (n = 10,735),

-Eleven from India,

-One from South Korea.

-One from the Eurasian trans-continent (n = 106), Turkey.

Results of Individual Studies

Among the 13 studies, six studies assessed periodontal diseases, four studies assessed dental caries, two studies assessed dental erosion, one study assessed TMJ disorders, and one study assessed oral cancer/oral mucosal lesions (Table 2). The studies focussed on workers from either mining or factory environments. Study results were expressed in the form of percentage or mean values to quantify the prevalence rates of each pathological lesion. Age and gender results were calculated separately to simplify the table (Table 3).

Methodological Quality of Included Studies

Thirteen included studies used a cross-sectional design. The Joanna Briggs Institute (JBI) critical appraisal checklist (2020)[7]for cross-sectional studies was applied to evaluate the methodological quality. Twelve cross-sectional studies were rated as strong, whereas one cross-sectional study was rated as moderate (Table 1). Q5 and Q6 were not applicable to selected studies, as the search strategy included only cross-sectional studies. Only one study (Study no.11) missed on the first question, rest all studies completely fulfilled the JBI evaluation, indicating that there was a very low risk of bias in the present systematic review.

Discussion

Standard of living has been improved by expanding industrial activity, but at the other end it has created many occupations related hazards[8]. Development in various fields such as technology, industrial, political, scientific, and social fields have led to various occupational and environmental diseasesthat have drawn public attention. [9]This review investigated the prevalence of pathological oral conditions in adult

workers arising due to occupational exposure. Most of the studies reviewed were conducted in India, with some conducted in South Korea and Turkey as well. From these studies, it was clear that there was a strong correlation between established pathologies and certain occupations. Workers from those occupations which had a definite exposure to abrasives, developed dental erosion, while those prone to chronic stress such as office workers developed TMJ disorders. Mine workers commonly developed increased rates of dental caries and periodontal diseases due to their working conditions. Similarly, those workers exposed to hazardous chemicals such as in a rubber factory showed increased prevalence of oral mucosal lesions.

Dental Caries

Four studies in this review assessed dental caries using the DMFT index. Majority of these studies focussed on workers in a mining environment, with one study based on workers in a factory. A very high prevalence of dental caries of 74%[9]was found in these studies with the highest mean DMFT score reported as 4.16 +/- 2.37[10]. On comparison with the general population, Janakiram et al. 2018 [11]reported prevalence rates of dental caries up to 78-84% in adult populations, while Miglani[12] reported rates as high as 85% in older populations. In this review, studies such Dileep et al., 2007[10] and Solanki et al. 2014[9] reported an increase in mean DMFT scores and prevalence ratewith increasing age, while otherssuch as Sanadhya et al. 2013[13] and Duraiswamy et al., 2008[14] showed a decline in prevalence rates as well as mean DMFT scores.

As these occupations are labour intensive, they employed more of men, with some studies reporting only men as participants. Even though some studies reported women as participants, they were usually less than the men. In those studies, which had both genders as participants, females were reported to have higher mean DMFT scores than men. Sanadhya et al. 2013 [13] reported that females had an almost double the average DMFT score than men, while Dileep et al.2007[10] reported a slight increase in female mean DMFT scores than men. This also agreed with Janakiram et al. 2018[11] which also reported higher prevalence of dental caries in females.

Dental Erosion

Two studies assessed dental erosion in this review, with Chaturvedi, 2015[15] using WHO Oral Health Assessment form 2013 (for adults) andGupta et al., 2015[16] using Tooth Wear Index (1984). These studies focussed on workers employed in factory settings such as a glass or fertilizer factory. A prevalence rate of about 77% was reported by both studies, which is comparatively higher than in the general population as reported by Hegde et al., 2018[17] and Jacob et al., 2019[18]. They reported prevalence of dental erosion to be 40.6% and 44% respectively. In this review, both included studies showed an increase in dental erosion prevalence with increasing age. The findings are in accordance with reports by Hegde et al.2015, 2018[17, 19] and Jacob et al. 2019[18] as well as Bartlett et al. 2011[20]. The increase in tooth wear with age can be attributed to the accumulation of etiological factors which results in increased severity and tooth surface loss overtime. Only Chaturvedi, 2015[15] reported both participants from both genders in this review, describing an increased prevalence of dental erosion in males (82.42%) in comparison with females (61.50%). This is agreement with Hegde et al.2018[17], Jacob et al.2019[18] as well as Al-Zarea 2012[21]. This could be due to the use of heavy masticatory forces in males and since females are more conscious about their oral health, thus allowing early detection of the disease and restoring the lesions.

Periodontal Diseases

Six studies assessed periodontal diseases in this review, using either WHO Oral Health Assessment form 1997/2013 or Community Periodontal Index (CPI)[8,9,22,23,24,25]. These studies focussed on workers in a mining or factory environment. They reported prevalence of periodontal disease ranging from as high as 100%[22]to as low as 86.27%[24]. This is in sharp contrast to the general population which reported a prevalence rate of 42.01% in a study by Selvaraj et al.2022[26].

On the other hand, all studies in this review reported an increase in CPI scores with advancing age. This is similar to reports by Selvaraj et al. 2022[26] as well as by Jagadeesan et al.2000[27] which conducted a study to assess the periodontal disease prevalence in Puducherry and found out the disease prevalence increased with age and the risk of being affected by periodontitis was 2-3 times for persons above 30 years of age than below.O f those studies in this review with both genders as participants, majority of them reported an increased prevalence of periodontal disease in men than in women. This agrees with reports by Ahamed et al. 2021[28]and Selvaraj et al.2022[26]indicating the poor oral hygiene practices of males as compared to females.

TMJ Disorders

Seo et al. 2012[29]was included in this review that assessed TMJ disease, which used a questionnaire-based approach to appraise this disease. This study focussed on office and service workers as well as teachers. It reported a 75.4% prevalence of TMJ disorders in this worker group. Muthukrishnanand Sekar, 2015[30] reported a prevalence of 53.7% in the general population, while Sachdeva et al.2020[31] reported a 0.43% prevalence rate of TMJ dysfunction. Majority of TMJ disease (80.90%) occurred in the younger population group of comprising of 18–30 yr. age group. This agrees with Chaurasia, et al., 2020[32] andSachdeva et al., 2020[31]who reported a higher prevalence of temporomandibular dysfunction in younger age groups. This contrasts with Muthukrishnan & Sekar, 2015[30]which reported a direct increase in prevalence with age. Seo et al. 2012[29],in this review reported females being more commonly affected by TMJ disorders than men with 80.90% of all females surveyed reporting TMJ discomfort. This agrees with Muthukrishnan& Sekar, 2015[30], Sachdeva et al., 2020[31] and Chaurasia, et al., 2020 [32].

Oral Mucosal Lesions

Solanki et al.2019[33]was included in this review that assessed prevalence of oral cancer or oral mucosal lesions using WHO Oral Health Assessment form 1997. This study focussed on workers in a rubber factory. It reported a 41.24% prevalence rate of oral mucosal lesions in workers in a factory setting. This contrasts with a 3.73% prevalence rate as reported by Pahwa et al.2018[34] in the general population. A trend of increasing prevalence was seen with age, the highest rate of 57.40% was reported in the 40-50 yr. age group. This in contrast with the general population which reported increased rates in the younger population as evidenced by reports of(Pahwa et al., 2018[34] andSharma et al., 2018[35]. Solanki et al.2019[33] only included male participants in his study so a gender-based comparison was not possible.

Limitations

It is possible that certain factors in each research or review process can alter the results. The main limitation of the results of the present review derives from the type of study design that was employed. For example, most of the evidence available is from observational studies, and specifically, from cross-sectional studies that can

only examine the outcome measures at one point in time; the lack of a longitudinal design, and/or comparison methods may affect the validity and consistency of the results.

The low number of studies may also affect the quality of this review. Some studies reported mismatched age intervals as well as including only male participants. We also acknowledge that the use of other databases apart from PubMed and Google Scholar could have yielded additional results, although we hypothesize that the result of our work would be similar. Therefore, although our systematic review confirms that there is an increased prevalence of most oral pathological lesions in an occupational setting, this result should be approached with caution.

Conclusion

This systematic review provides aggregated information about occupational exposure and its effect on oral health. A definite relation was seen between certain occupations and occurrence of certain oral pathological lesions. With exception of only dental caries, all other pathologies that were studied showed an increased prevalence in workers employed in either a mining or factory setting in comparison to the general population. Given the scarcity of information on the oral health of workers, more studies are needed as they will inform policy as well as interventions. Nevertheless, this review assisted in identifying and confirming the at-risk workers, providing a background for the development of strategies that will ultimately target the risk factors to potentially improve their oral health, refining oral care for this specific at-risk, deprived population. Therefore, the findings of this review increase the awareness of healthcare policymakers and health promotion teams regarding oral health.

Supplementary Materials

Appendix 1: Lists of included studies, Table S1: PRISMA checklist 2020, Table S2: PRISMA abstract checklist 2020, Table S3: MEDLINE (PubMed) search strategy—12 July2022, Table S4: Google Scholar search strategy—12 July 2022, Table S5: Details of excluded studies (n = 77)

The protocol of the study was registered with the PROSPERO database under reference number-CRD42022342398

Availablefrom: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42022342398

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Legend Tables

Table 1: Methodological quality for cross-sectional studies

S.No.	Authors	Study Title	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Total Score n/16	Level of Quality
1.	Sankethguddad et al., 2020[22]	An epidemiological study to assess periodontal status among sugar factory workers of Karad taluka using community periodontal index	Y	Y	Y	Y	N/A	N/A	Y	Y	12	Strong
2.	Dayma et al., 2019[23]	Appraisal of periodontal condition amongst leather manufacturing plant workers in central India: A prevalence survey	Y	Y	Y	Y	N/A	N/A	Y	Y	12	Strong
3.	Solanki et al., 2019[33]	Periodontal health status, oral mucosal lesions, and adverse oral habits among rubber factory workers of Bahadurgarh, Haryana, India	Y	Y	Y	Y	N/A	N/A	Y	Y	12	Strong
4.	Baishya et al., 2018[24]	Oral hygiene status, oral hygiene practices and periodontal health of brick kiln workers of Odisha	Y	Y	Y	Y	N/A	N/A	Y	Y	12	Strong
5.	Chaturvedi et al., 2015[15]	Assessment of tooth wear among glass factory workers: WHO 2013 oral health survey	Y	Y	Y	Y	N/A	N/A	Y	Y	12	Strong
6.	Gupta et al., 2015 [16]	Assessment of oral hygiene habits, oral hygiene practices and tooth wear among fertilizer factory workers of Northern India: A Cross sectional study	Y	Y	Y	Y	N/A	N/A	Y	Y	12	Strong
7.	Solanki et al., 2014[9]	Oral health of stone mine workers of jodhpur city, Rajasthan, India	Y	Y	Y	Y	N/A	N/A	Y	Y	12	Strong
8.	Nagarajappa et al., 2013[25]	Assessment of the periodontal status among Kota stone workers in Jhalawar, India	Y	Y	Y	Y	N/A	N/A	Y	Y	12	Strong
9.	Sanadhya et al., 2013[13]	The oral health status and the treatment needs of salt workers at sambhar lake, Jaipur, India	Y	Y	Y	Y	N/A	N/A	Y	Y	12	Strong
10.	Duraiswamy et al., 2008[14]	Dental caries experience and treatment needs of green marble mine laborers in Udaipur district, Rajasthan, India	Y	Y	Y	Y	N/A	N/A	Y	Y	12	Strong
11.	Dileep et al., 2007[10]	Dental caries experience and oral hygiene status of biscuit factory workers in Kanpur city	N	Y	Y	Y	N/A	N/A	Y	Y	10	Moderate
12.	Seo et al., 2012[29]	Temporomandibular disorders and risk factors in office workers, service workers, and teachers	Y	Y	Y	Y	N/A	N/A	Y	Y	12	Strong

13.	Cengiz et al., 2018[8]	Prevalence of periodontal disease among mine workers of Zonguldak, Kozlu District, Turkey: a cross-sectional study	Y	Y	Y	Y	N/A	N/A	Y	Y	12	Strong
		TOTAL	12	13	13	13	--	--	13	13		

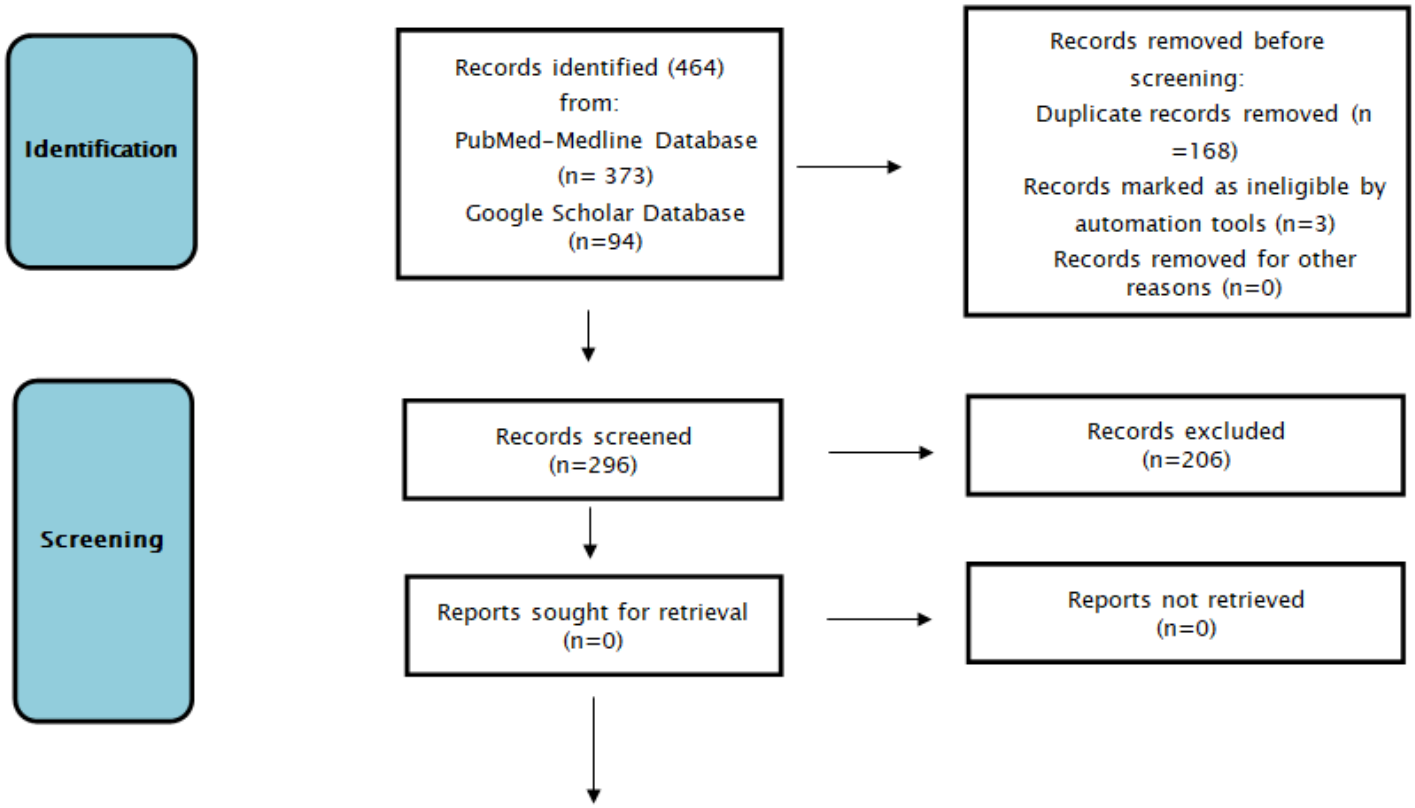
Note. Y: Yes = 2; UC: Unclear = 1; N: No = 0; NA: Not applicable = 0; Weak: 0–5; Moderate: 6–11; Strong: 12 or above

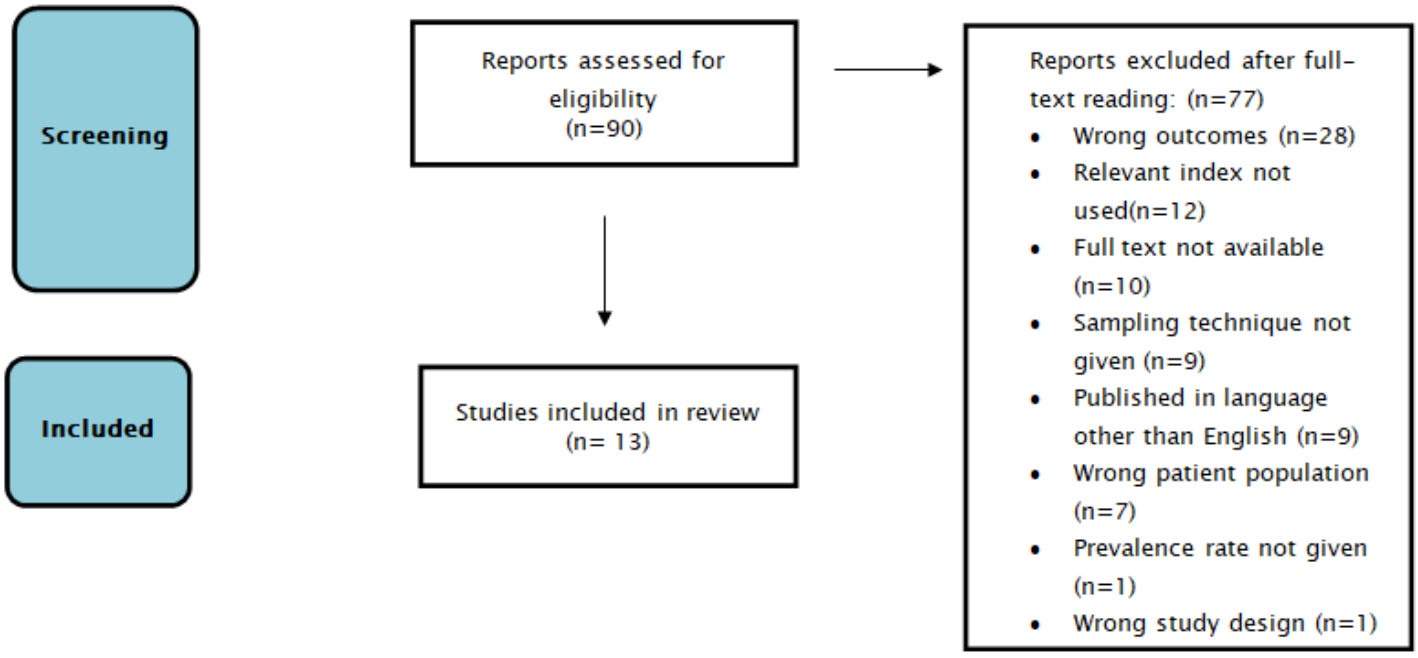
Table 3: Age and Gender Wise Results

Author, Year of publication	Workplace/ Occupational group	Number of Subjects				Prevalence Rate (Percentage/ Mean value)				Number of Subjects		Prevalence Rate (Percentage/ Mean value)	
		18-30 years	30-40 years	40-50 years	Above 50 years	18-30 years	30-40 years	40-50 years	Above 50 years	Male	Female	Male	Female
ASIA													
INDIA													
Sankethguddad et al., 2020[22]	Sugar factory workers	611	354	208	208	100%	100%	100%	100%	887	286	100%	100%
Dayma et al., 2019[23]	Leather factory workers	390	280	280	180	89.80%	92.90%	92.90%	95%	498	352	92%	91.50%
Solanki et al., 2019[33]	Rubber factory workers	728	983	702	877	25.80%	34.50%	57.40%	52.10%	3290	-	-	-
Baishya et al., 2018[24]	Brick kiln workers	70	166	142	30	57.10%	63.90%	81.70%	86.70%	300	108	69.40%	72.30%
Chaturvedi et al., 2015[15]	Glass factory workers	8	709	147	72	0%	74.19%	98.64%	62.50%	671	265	82.42%	61.50%
Gupta et al., 2015[16]	Fertilizer factory workers	269	258	277	161	62.50%	73.30%	85.60%	93.30%	965	-	-	-
Solanki et al., 2014[9]	Stone mine workers	140	187	120	63	2.40 +/- 0.6, 82.2%	2.76 +/- 1.12, 100%	3.59 +/- 1.23, 100%	2.80 +/- 1.11, 100%	510	-	-	-
Nagarajappa et al., 2013[25]	Limestone mine workers	137	142	76	65	94.90%	100%	100%	100%	350	70	99.71%	91.43%
Sanadhya et al., 2013[13]	Salt lake workers	297	324	255	103	3.50 +/- 2.43	4.09 +/- 3.52	2.42 +/- 1.52	2.88 +/- 2.10	509	470	2.58 +/- 1.89	5.19 +/- 4.11
Duraiswamy et al., 2008[14]	Marble mine workers	171	162	135	45	78.9%, 2.83	72.2%, 3.44	73.3%, 2.06	60%, 3.20	513	-	-	-
Dileep et al., 2007[10]	Biscuit factory	130	90	70	40	3.28 +/-	4.26 +/-	4.31 +/-	6.24 +/-	265	73	4.13 +/- 2.33	4.26 +/- 2.50

	workers					1.89	2.01	2.56	2.69				
SOUTH KOREA													
Seo et al., 2012[29]	Office workers	152	160	41	-	80.90%	76.20%	51.20%	-	112	241	63.40%	80.90%
EURASIAN TRANS-CONTINENT													
TURKEY													
Cengiz et al., 2018[8]	Coal mine workers	84	84	22	22	95.20%	95.20%	100%	100%	106	-	-	-

Figure 1: PRISMA Flow Diagram





Note. Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) flow diagram: This figure shows the study selection process for included studies on occupational diseases of the oral cavity.