

## ORIGINAL ARTICLE

# Current knowledge, attitude and practice among dental hygienists in oral cancer awareness: Systematic review

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## Funding information

This article has no funding source.

## Abstract

**Objectives:** Evidence on the awareness and knowledge level of oral cancer and its associated risk factors among dental hygienists is scarce; this systematic review aimed to synthesize their available evidence of the level of knowledge, attitude and practice.

**Methods:** PubMed and Scopus were searched for publications from any year up to January 2021. Studies about knowledge and/or attitudes and/or practices of dental hygienists have been taken into account. Overall, 14 studies have been selected for the systematic review.

**Results:** Excluding tobacco use (99.8%–100%), considerable variability were found among dental hygienists about important oral cancer risk factors such as alcohol consumption (30.0%–90.0%), human papilloma virus (23.0%–90.0%), oldness (37.7%–69.3%), diet (30.0%–42.2%) and betel quid chewing (5.0% and 98.0%). There was a good level of awareness among dental hygienists regarding leukoplakia (86.5%), instead less than half recognized erythroplakia as a precancerous lesion. Moderate knowledge was recorded about frequent sites of oral cancer development. Most of dental hygienists reported to perform intraoral screening (85.2%–100%). To regard attitude, a great variability was found about adequacy of undergraduate training (15.7%–75.0%) and most of dental hygienists expressed the need for continuing education (92.7%–99.0%).

**Conclusions:** Dental hygienists play a key role in oral cancer detection. Low knowledge of oral cancer among dental hygienists is strongly associated with the low levels of early detection. These findings provide useful information to improve continuing education programmes pre- and post-graduation targeted at the prevention of oral cancer in order to reduce oral cancer morbidity and mortality.

## KEYWORDS

attitude, dental hygienists, knowledge, oral cancer, prevention, screening

## 1 | INTRODUCTION

Oral cancer (OC) is a significant public health issue, representing 18th most common malignancy in the world.<sup>1</sup> The Global Cancer

Incidence, Mortality and Prevalence database (GLOBOCAN) worldwide data for lip and OC are of 377,713 of new cases and 177,757 of new deaths, accounting 2.0% of new estimated cases of all cancers and 1.8% estimated death for cancer.<sup>2</sup> Unfortunately, the OC

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five-year survival rate is still low (50% overall), and it has not improved in the last few decades.<sup>3</sup> The prognosis at early stage is relatively good with survival rates around 84%, while it worsens drastically for the advanced stages, whose survival rates are around 39%.<sup>4</sup> One of the main factors related to these poor prognostic data is the diagnostic delay; in fact, in a significant percentage of patients, OC is often identified at advanced stages (III or IV),<sup>5</sup> resulting in a more aggressive treatments, increased related-side effects, and poorer prognosis.<sup>6</sup> This is because patients do not recognize early signs and symptoms of OC and require medical attention in an advanced stage of the disease; besides, many of them are unaware that the oral cavity can be the site of malignancy.<sup>7</sup> In addition to the lack of public awareness, diagnostic delay by primary care providers contributes to higher patient mortality and morbidity.<sup>8</sup> The main causes of professional delay include inadequate oral examination, low index of suspicion, poor knowledge about the disease, its risk factors, such as tobacco smoking, alcohol assumption and oral Human papillomavirus (HPV) infection,<sup>1,3,7</sup> and lack of attitude and practice with OC.<sup>9</sup> These data contrast with the need for early diagnosis that is crucial to prolong the patient's life.<sup>10</sup> To date, the visual inspection remains the main tool for the OC screening.<sup>11,12</sup> In fact, in the majority of cases, OC is preceded by potentially malignant oral disorders (OPMDs) that can be easily diagnosed during oral mucosa examination with the potential to make a dramatic difference in the rates of early detection.<sup>13</sup> To improve visual inspection, some diagnostic tools, such as optical fluorescence imaging, have been proposed; however, their clinical efficacy is controversial and the practitioner training plays a key role.<sup>14</sup> Dental hygienists (DHs) have a specific skill to assess all oral tissues and differentiate between normal, healthy soft tissue and abnormal or diseased tissues. The dental hygiene appointment is naturally predisposed to OC screenings as a part of routine dental hygiene care.<sup>15</sup> So, it is important to understand what DHs know and believe about OC, and their practices in assessing risk factors and performing intraoral and extraoral examinations.

The aim of this study is to determine the knowledge, attitude and practices (KAP) among DHs regarding OC. The understanding of KAP is a key step to minimize OC risk, improve prevention and control measures, and apply detection procedures, because OC can be recognized at an early stage by visual and tactile examination.<sup>16</sup>

In this systematic review, all studies measuring OC-KAP among DHs have been collected with the purpose to summarize knowledge, feelings and behaviours among DHs.

## 2 | MATERIALS AND METHODS

The systematic review relied on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement with the use of PICO (Population, Intervention, Comparison, Outcome) and SPIDER (Sample, Phenomenon of Interest, Design, Evaluation and Research Type) tools in order to structure the research questions<sup>17-19</sup> 'What is KAP among DHs on OC?' and 'What is DHs' KAP on OC in questionnaire-based surveys?', respectively.

### 2.1 | Eligibility criteria

The review included qualitative, quantitative and mixed-method studies written in English language. Studies investigating the current knowledge status and/or skills and/or attitudes and/or perceptions and/or practices, and/or behaviours of DHs have been taken into account.

### 2.2 | Search strategy

The databases used are PubMed and Scopus. The search strategy was based both on Medical Subject Headings (MeSH) and on the following key words, in multiple combinations, that were chosen to reflect the focus of the review: 'oral cancer', 'oral neoplasm', 'oral malignant', 'knowledge', 'awareness', 'early detection' and 'prevention'. The search equations used with MeSH were '((((Mouth Neoplasms/diagnosis'[Mesh] OR 'Mouth Neoplasms/prevention and control'[Mesh])) AND 'Health Knowledge, Attitudes, Practice'[Mesh]) AND 'Early Detection of Cancer'[Mesh]'. Studies published up to January 2021 (included), from any year, were sought. In addition, the search has been supplemented by searching of the reference lists of included studies.

### 2.3 | Study selection

Two authors (R.I. and C.N.) were involved in the literature search. The choice of the reference studies has been made firstly on the screening of titles and abstracts of all the articles after the exclusion of duplicates, in an unblinded but independent process. The independent lists were cross-referenced; any disagreement was resolved by consensus or with a third-party reviewer (L.S.). Then, in line with inclusion and exclusion criteria (Table 1), a full-text eligibility assessment has been performed by the two reviewers in a blinded process, after which the process of referencing and citation searching was made. A 100% agreement rate was obtained between the two authors.

### 2.4 | Data extraction and data synthesis

To assess the aim of the review, the following data were collected: author's name, year of publication, purpose of study, sample size, OC-related items explored in the questionnaire-based surveys classified in three distinct domains, including knowledge, attitude, practice, and outcomes related to these domains. In particular, the knowledge related items consisted of eleven statements about risk factors, seven about non-risk factors, six regarding OPMDs, six related to common sites of development, eleven about clinical presentation. Sixteen statements investigated attitude items. To regard practice items, three statements were associated with physical examination, seven with history taking and one referral to a specialist. Not all items were analysed in all studies, therefore, for each item the percentage of studies in which it was included was calculated. A detailed explanation on explored items in the questionnaires and

TABLE 1 Inclusion and exclusion criteria

Criteria		Inclusion	Exclusion	
Language			Non-English	
S	P	Sample	DHs involved in OC management	Non DHs
PI		Phenomenon of interest	OC topics	Non-OC topics
	I	Intervention	Questionnaire-based survey and interview assessing knowledge OR/AND attitude OR/AND practice (See Table 2)	Non questionnaire-based survey
D		Design of study	Cross sectional studies/Comparative cross-sectional studies/RCTs, Non-RCTs	Reviews, opinion-based studies, letter to editors, case reports, study protocols
	C	Comparison	Comparison of KAP among different HCPs when available	-
E	O	Evaluation (E) (O)	DHs' knowledge status/skills//attitudes/perceptions/ views/opinions/practices/behaviours	Unrelated with DHs' knowledge status/ skills/ attitudes/ perceptions/views/opinions/ practices/behaviours
R		Research type (R)	Qualitative studies, quantitative studies, and mixed-method studies	-
		Geographical area of interest	Worldwide	-
		Study focus	Studies investigating the knowledge AND/OR attitudes AND/OR practices/behaviours of DHs towards oral health topics Studies investigating almost two among knowledge, attitude and practice. Studies investigating the impact of OSCC/OC educational interventions on DHs' knowledge AND/OR attitudes Studies focusing only on data about single categories of DHs	Studies investigating the OC knowledge AND/OR attitudes AND/OR practices of medical/dental students Studies investigating the knowledge AND/OR attitudes AND/OR practices of HCPs towards other oral health related topics Studies with inadequate data Studies focusing on aggregated data per individual categories of HCPs

Abbreviations: DH, dental hygienists; HCP, health care practitioner; KAP, knowledge, attitude and practice study; OC, oral and pharyngeal cancer; OSCC, oral squamous cell carcinoma.

surveys and the number of studies in which each item was included are reported in Table 2. For each question percentages of correct answers were reported in tables, while in manuscript only the range values were reported. As different questionnaires were used among different studies, questions were summarized on the basis of topics in order to make a comparison. A standardized form was used to extract data from the included studies.

## 2.5 | Quality assessment

Quality assessment preceded data extraction. The quality of the studies was assessed based on the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) scale.

## 3 | RESULTS

PubMed and Scopus research produced 149 abstracts; after removing duplicates and, in compliance with the study protocol, a detailed screening of titles and abstracts of the manuscripts was made (Figure 1). The reporting of literature review on the KAP key question returned 14 studies divided per categories as follows:

10 among Dental hygienists, 4 between Dentists and Dental Hygienists.

Ten studies were conducted in America,<sup>20-29</sup> two in Europe,<sup>30,31</sup> one in Australia<sup>32</sup> and one in Japan and Australia<sup>33</sup> (Table 3).

### 3.1 | Knowledge

Most studies indicated good knowledge among dental hygienists about OC risk factors like tobacco use (99.8%–100%)<sup>21,23,24,26-31,33</sup> and past positive OC history (56.6%–97.3%).<sup>21,24,26,27,30,31</sup> However, considerable variability in knowledge levels was noticed among participants regarding other risk factors, including alcohol (30.0%–90.0%),<sup>21,23,24,26-31,33</sup> oral HPV infection (23.0%–90.0%),<sup>24,33</sup> advanced age (37.7%–69.3%),<sup>21,23,24,26,27,29-31</sup> diet (27.1%–42.2%)<sup>23,24,26,27,29,30</sup> and betel quid chewing (5.0%–98.0%).<sup>23,33</sup>

OPMDs correctly identified by dental hygienists included Leukoplakia (86.5%)<sup>31</sup> and Erythroplakia (46.8% and 48.4%).<sup>24,31</sup> Moreover, there were three studies where questions about Leukoplakia and Erythroplakia were combined into a single item (16.4%–71.2%).<sup>24,27,29</sup> Regarding clinical picture items dental hygienists were generally aware about OC (53.1%–57.1%),<sup>27,31</sup> positive lymph node characteristics (58.4%–67.4%),<sup>24,27,29,31</sup> asymptomatic

**TABLE 2** OC-related items explored in the questionnaire-based surveys

Items explored	No. of studies in which each item was included (%)
<b>Knowledge</b>	
<b>1. Risk factors</b>	
Tobacco use is a risk factor for OC	71.4%
Alcohol consumption is a risk factor for OC	71.4%
History of previous OC is a risk factor for OC	42.9%
Advanced age is a risk factor for OC	57.1%
HPV infection is a risk factor for OPC	14.3%
Sun exposure is a risk factor for lip cancer	42.9%
Poor diet is a risk factor for OC	42.9%
Betel quid chewing is a risk factor for OC	14.3%
Fungal infection is a risk factor for OC	0%
Immunosuppression is a risk factor for OC	0%
Radiotherapy is a risk factor for OC	0%
<b>2. Non-risk factors</b>	
Family history	21.4%
Familiar clustering	7.1%
Ill-fitting prosthesis	14.3%
Hot food and drink	7.1%
Poor oral hygiene	14.3%
Use of spicy food	14.3%
Obesity	14.3%
<b>3. OPMDs</b>	
Leukoplakia is a precancerous oral lesion	28.6%
Erythroplakia is a precancerous oral lesion	28.6%
Lichenoid lesions are a precancerous oral lesion	0%
Chronic hyperplastic candidiasis is a precancerous oral lesion	0%
Actinic cheilitis is a precancerous oral lesion	0%
Oral submucous fibrosis is a precancerous oral lesion	0%
<b>4. Common sites of development</b>	
Lips are common sites for OC development	0%
Tongue is a common site for OC development	28.6%
Floor of the mouth is a common site for OC development	28.6%
Buccal mucosa is a common site for OC development	0%
Palate is a common site for OC development	0%
Gum is a common site for OC development	0%

**TABLE 2** (Continued)

Items explored	No. of studies in which each item was included (%)
<b>Knowledge</b>	
<b>5. Clinical presentation</b>	
Squamous carcinoma is the most common form of OC	28.6%
OC is asymptomatic at early stage	21.4%
OC is diagnosticated more frequently at advanced stage	21.4%
Lymph node characteristic of OC metastasis	28.6%
Early OC lesions appear as small, painless red area	28.6%
Ventral lateral border of the tongue most likely to develop OC	21.4%
Submandibular lymph nodes are the first places of metastasis of OC	0%
Lung is the most common site of distant metastasis of OC	0%
Persistent ulcer, Lump, Non-healing socket, bleeding gums could be signs of OC	0%
Dysphagia could be sign of OC	0%
Limited tongue mobility could be sign of OC	0%
<b>Attitude</b>	
Adequate/inadequate OC education received at dental school	35.7%
Quality of OC education	35.7%
Up-to-date knowledge	42.9%
Need to perform annual OC screening examinations for patients >40 years old	7.1%
Early detection improves 5-year survival rate	28.6%
Training level in providing education on smoking cessation	35.7%
Training level in OC examination/ screening	
Believe/Not believe dental hygienist are qualified to perform OC examination	28.6%
Comfortable/Uncomfortable during neck lymph nodes palpation	0%
Comfortable/Uncomfortable to refer suspicious oral lesions to specialists	0%
Confident/Non-confident in diagnosis of OC from clinical appearance	0%
Patients' knowledge level about risk factors	7.1%
Should/Should not inform patients about findings	0%
Advice/Not advice patients with suspicious oral lesions	0%
Need of continuous education regarding the examination and early detection for OC	28.6%

TABLE 2 (Continued)

Attitude	
Adequately/Not adequately preparation to explain the risks of tobacco/alcohol use	35.7%
Practice	
Extra/Intraoral examination	64.3%
Lymph nodes palpation	14.3%
Use of blue toluidine/fluorescent light	7.1%
Asking about current/previous use of tobacco	42.6%
Asking about the type and amounts of tobacco products used	35.7%
Asking about current/previous use of alcohol	35.7%
Asking about the type and amounts of alcohol use	35.7%
Asking about personal/family history of cancer	21.4%
Asking about type of diet	0%
Asking about sun exposure	0%
Refer to a specialist (as Oral and Maxillofacial Surgeons, Oral Medicine specialists, ENT, Physicians, specialized Hospital)	0%

Abbreviations: ENT, Otolaryngologist; OC, oral cancer; OPC, oropharyngeal cancer.

at early stage (74.7%–75.8%),<sup>24,27,29</sup> OC diagnosis at III/IV stage (35.4%–50.3%),<sup>24,27,29</sup> and tongue high-risk area (58.9%–67.9%).<sup>27,31</sup> Considerable variability in knowledge of common sites of development was noticed regarding tongue (83.0%–88.8%)<sup>24,31</sup> and floor of mouth (13.5%–62.8%).<sup>24,31</sup>

### 3.2 | Attitude

Attitude was reported only in 9 studies (64.3%)<sup>21,23,26-31,33</sup>; they identified the following items: 'visual examination is effective in early detection' (73.1%–76.7%),<sup>26,27,29,33</sup> 'undergraduate training was adequate' (15.7%–75%),<sup>20,23,26,29,30</sup> 'up-to-date knowledge' (44.7%–91.9%)<sup>20,21,23,26,27,29</sup> and 'need of continuing education (CE)' (92.7%–99.0%).<sup>21,26,27,29</sup>

### 3.3 | Practice

Six out fourteen of studies assessed history taking by dental hygienists.<sup>22,23,25,26,28,31</sup> Regarding physical examination, they identified the following items: intraoral examination (85.2%–100%),<sup>20,27,29,32,33</sup> extraoral examination (75.0%–90.0%),<sup>20,32</sup> intraoral and extraoral

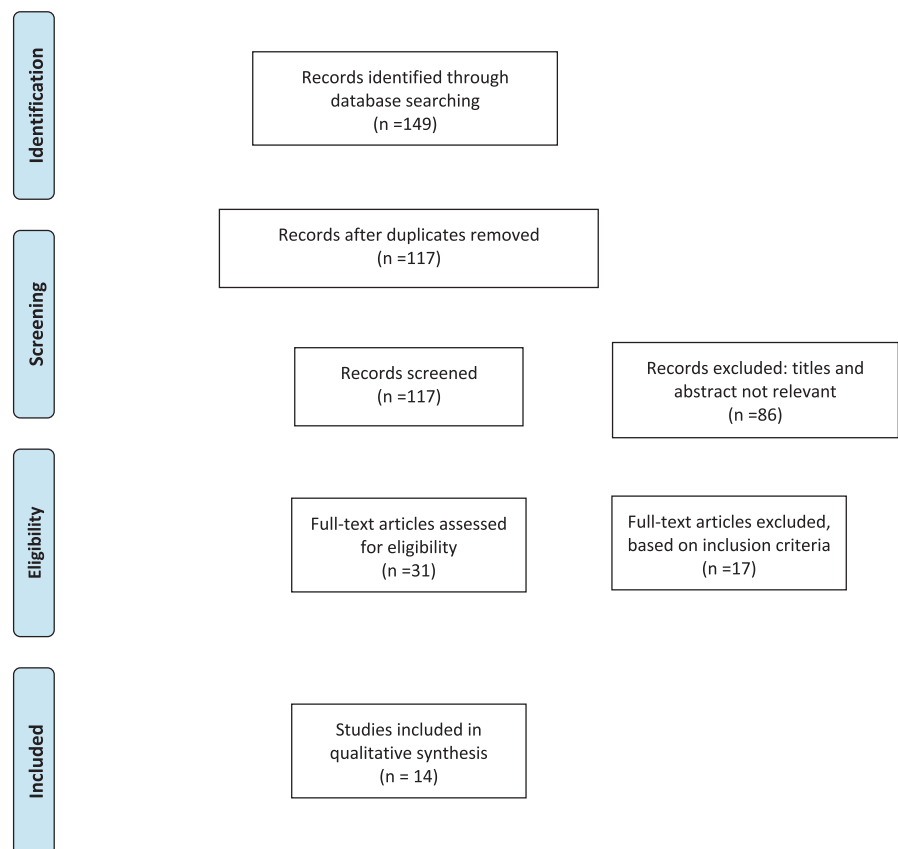


FIGURE 1 PRISMA flow diagram

TABLE 3 Published Data about Dental hygienists' KAP on OC

References	Participants	Quality assessment	Knowledge	
			Risk Factors	Precancerous lesions
Clarke A.K. et al., 2017 <sup>20</sup>	256	>70%	N.A.	N.A.
Mariño R. et al., 2017 <sup>32</sup>	46	>70%	N.A.	N.A.
Haresaku S. et al., 2016 <sup>33</sup>	55 Japanese 45 Australian	>70%	Japanese: Tobacco 80% Family history 68% Alcohol 30% HPV 23% Caffeine 17% Betel quid chewing 5% Australian: Tobacco 100% Betel quid chewing 98% Alcohol 96% HPV 90% Family history 90% Caffeine 5%	N.A.
Tax C. L. et al., 2015 <sup>21</sup>	212	>70%	Tobacco 58% Prior OC 56.6% Alcohol 39.6% Advanced age 37.7%	N.A.
Walsh M. M. et al., 2013 <sup>22</sup>	1463	>70%	N.A.	N.A.
Gajendra S. et al., 2006 <sup>23</sup>	630	>70%	Tobacco 90% Alcohol 80% Sun exposure 60% Advanced age 55% Diet 30% Betel quid chewing 28% Gutka consumption 11%	N.A.
López-Jornet P. et al., 2006 <sup>30</sup>	140	>70%	Tobacco 100% Alcohol 90% Ill-fitting prosthesis 83.6% Prior OC 82.1% Family history 80.7% Advanced age 59.3% Poor oral hygiene 54% Sun exposure 50.7% Diet 42.1% Spicy food 13.6% Obesity 17.1%	N.A.

Clinical Picture	Common sites of development	Attitude	Practice	
		Opinion	History Taking	Physical examination
N.A.	N.A.	Up-to-date knowledge 70% Undergraduate training was adequate 60%	N.A.	Intraoral 99% Extraoral 90%
N.A.	N.A.	N.A.	N.A.	Intraoral 100% Oropharynx 100% Extraoral 87.2% Lymph nodes 76.3%
N.A.	N.A.	Japanese Visual examination is effective in early detection 75.5%	N.A.	Japanese Intraoral 100% Extraoral 75% Lymph nodes 55% Oropharynx 15% Australian Intraoral 100% Extraoral 82.1% Lymph nodes 64.1% Oropharynx 23.7%
N.A.	N.A.	Need of CE 99% Up-to-date personal knowledge 91.9%	N.A.	Intra and extraoral examination at 1st visit 36% at recall 20%
N.A.	N.A.	N.A.	Tobacco 62.7%	Intra and extraoral 93.6% Brush biopsy 14.7% Toluidine blue 1.8% VizLite 2.2%
N.A.	N.A.	Lack of patient knowledge 75% Undergraduate training was adequate 60% Skills on neck examination 55% Dental hygienist skills on visual examination 50% Previous CE courses 50% Up-to-date personal knowledge 48% Smoking cessation is effective 20% Alcohol cessation is effective 10%	Prior OSCC 79% Tobacco 70% Tobacco products 65% Family history 55% Alcohol 40% Alcohol products 25%	N.A.
N.A.	N.A.	Adequate knowledge 42.9% Previous CE courses 36.4% Undergraduate training was adequate 15.7%	N.A.	N.A.

TABLE 3 (Continued)

References	Participants	Quality assessment	Knowledge	
			Risk Factors	Precancerous lesions
Ashe T. E. et al., 2006 <sup>24</sup>	651	>70%	Tobacco 99.8% Alcohol 86.5% Prior OC 97.8% HPV 47.1% Advanced age 58.4% Sun exposure 67% Diet 27.1% Hot food and drink 77.9% Use of spicy foods 76.4% Poor oral hygiene 60.7% Obesity 77.2% Family clustering 29.3% Ill-fitting prosthesis 26.2% Family history 8.7%	Erythro/Leuko 71.2% Erythroplakia 46.8%
Cruz G. D. et al., 2005 <sup>25</sup>	963	>70%	N.A.	N.A.
Nicotera G. et al., 2004 <sup>31</sup>	215	>70%	Tobacco 99.5% Prior OC 95.8% Advanced age 49.3% Alcohol 34.9%	Leukoplakia 86.5% Erythroplakia 48.4%
Forrest J. L. et al., 2001 <sup>26</sup>	464	>70%	Tobacco 99.8% Prior OC 97.3% Alcohol 89.8% Advanced age 69.3% Sun exposure 55.8% Diet 42.2%	N.A.
Forrest J. L. et al., 2001 <sup>27</sup>	464	>70%	Tobacco 99.8% Prior OC 97.3% Alcohol 89.8% Advanced age 69.3% Sun exposure 55.8% Diet 42.2%	Erythroplakia & Leukoplakia 18%



Clinical Picture	Common sites of development	Attitude		Practice	
		Opinion		History Taking	Physical examination
Asymptomatic at early stage 75.7% Painless red patch 74.4% Positive lymph node 65.1% OSCC 61.1% OSCC diagnosis at III/IV stage 38.3%	Floor of the mouth 62.8% Tongue 83%	N.A.		N.A.	N.A.
N.A.	N.A.	N.A.		Tobacco 78.5% Tobacco products 73% Alcohol 42.5% Alcohol products 28%	Intra and extraoral examination at 1st visit 79% at recall 76%
OSCC time diagnosis >60 yrs 74.5% Tongue high-risk area 67.9% Positive lymph node 63.7% OSCC 53.1% Red patch 42.8%	Tongue 88.8% Floor of the mouth 13.5%	Annually visual inspection for patients over 40 is mandatory 80.9%		Tobacco 94% Tobacco products 94% Alcohol products 67.4% Family history 51.2% Prior OSCC 51.2% Alcohol 44.5%	Intra and extraoral 87%
OSCC time diagnosis >60 yrs 19.3%	N.A.	Need of CE 92.7% Visual examination is effective in early detection 73.1% Undergraduate training was adequate 66.7% Skills on neck examination 60.3% Up-to-date personal knowledge 44.7% Smoking cessation is effective 27.1% Alcohol cessation is effective 11.2%		Prior OSCC 88% Tobacco 84.5% Tobacco products 78% Family history 60% Alcohol 44.5% Alcohol products 27%	N.A.
Asymptomatic at early stage 74.7% Red patch 70.3% Positive lymph node 58.4% OC diagnosis (III/IV stage) 35.4% Tongue high-risk area 58.9% OSCC 57.1% OSCC time diagnosis >60 yrs 19.3%	Tongue and floor of the mouth 53.6%	Need of CE 93.1% Visual examination is effective in early detection 73.5% Previous CE courses 66.7% Skills on neck examination 60.5% Up-to-date personal knowledge 45.8% Smoking cessation is effective 27.3% Alcohol cessation is effective 11.2%		N.A.	Intraoral 85.2%

TABLE 3 (Continued)

References	Participants	Quality assessment	Knowledge	
			Risk Factors	Precancerous lesions
Syme S. E. et al., 2001 <sup>28</sup>	331	>70%	Tobacco 99.7% Alcohol 89.3%	N.A.
Syme S. E. et al., 2000 <sup>29</sup>	331	>70%	Tobacco 100% Prior OC 97% Alcohol 73% Advanced age 65% Sun exposure 55% Diet 30%	Erythroplakia & Leukoplakia 16.4

Abbreviations: CE, continuing education; OC, oral cancer; OSCC, Oral squamous cell carcinoma.

examination as single item (36.0%–87.0%)<sup>21,22,25,31</sup> and lymph nodes examination (55.0%–76.3%).<sup>32,33</sup>

## 4 | DISCUSSION

KAP studies are one of the best ways to assess health care delivery by identifying gaps in knowledge, facilitating educational processes, with the important advantage of collecting a large amount of qualitative and quantitative data that will be subjected to statistical analysis. While 'Knowledge' has more objective items to assess, 'Attitude' is difficult to analyse because it is strictly related to personal characteristics of an individual, including cognitive and affective feeling elements, and propensity to action.<sup>34</sup> This is the first systematic review that described KAP among DHs.

To regard DHs knowledge about risk factors, they showed a good level of knowledge on tobacco use and history of previous oral and maxillofacial malignancy risk factors, compared to others risk factors such as alcohol, advanced age, sun exposure, oral HPV infection and Diet, which were identified only by a small number of participants. Furthermore, DHs tend to incorrectly identify Family history,<sup>24,30,33</sup> Ill-fitting prosthesis,<sup>24,30</sup> Family clustering<sup>24</sup> and Poor oral hygiene<sup>24,30</sup> as risk factors and little less than 30% reported incorrectly that use of spicy food<sup>24,30</sup> and obesity<sup>24,30</sup> are risk factors. These data have demonstrated a relatively high level of misinformation in this group that could be attributed to the use of partially inaccurate resources during the undergraduate programmes. DHs need to be aware of all OC risk factors including emerging ones. The generally accepted risk factors are tobacco uses in various forms, betel quid chewing and

alcohol consumption.<sup>35</sup> To date, also oral HPV infection has been recognized to play a role in the pathogenesis of OC mainly associated with oral carcinoma; it is related to high-risk genotypes of HPV infection.<sup>36</sup> Recognizing OC patients with HPV infection is very crucial since HPV-related OC patients respond better to certain chemotherapy and radiotherapy.<sup>37</sup> As a result, they have a better curable rate and prognosis. Some studies have focused on DHs' KAP about relationship between HPV and oral cancer. Results from these studies are discordant, however, most of them indicate a knowledge gap in specific HPV-related topics, including the HPV infection, curability, prevention, vaccination and screening.<sup>38-41</sup> DHs spend a lot of time interacting with patients, which may indicate an opportunity to provide HPV-related prevention information to their patients during routine dental visit. By this way DHs can be part of the next group of health care providers involved in HPV-related cancer prevention programmes and due to their training, have a remarkable position as educators and prevention specialists.<sup>38</sup>

The DHs knowledge levels about OMPDs was shown low/moderate. Only 4 out of 14 studies evaluated this item,<sup>24,27,29,31</sup> only Erythroplakia and Leucoplakia were investigated. No studies analysed oral submucous fibrosis (OSMF), oral lichen planus, actinic cheilitis, palatal lesions in reverse smokers, oral lupus erythematosus, dyskeratosis congenita, oral lichenoid lesion and oral graft versus host disease that have been also listed as OPMDs.<sup>42</sup>

With respect to clinical pictures items, the results obtained were below expectations: slightly more than 50% of them were able to identify that the most common form of OC is squamous,<sup>24,27,29,31</sup> the characteristics of an early OC<sup>24,27,29,31</sup> and of a positive lymph node.<sup>24,27,29,31</sup>

Clinical Picture	Common sites of development	Attitude		Practice	
		Opinion		History Taking	Physical examination
N.A.	N.A.	Smoking cessation is effective 13.7%		Tobacco 86% Tobacco products 79.1% Alcohol 54.8% Alcohol products 29.9%	N.A.
Asymptomatic at early stage 75.8% Red patch 74% Positive lymph node 67.4% Tongue high-risk area 62% OSCC 55.8% OSCC diagnosis (III/IV stage) 50.3% OSCC time diagnosis >60 yrs 10%	Tongue and Floor of the mouth 53.3%	Need of CE 96% Visual examination is effective in early detection 76.7% Undergraduate training was adequate 75.1% Up-to-date personal knowledge 46.4% Skills on neck examination 40.7% Smoking cessation is effective 32.1%		N.A.	Intraoral 90.6%

Similarly, happened with regard to common sites of development items investigated only in four studies: slightly more than 50% of participants were able to identify high-risk areas with major consensus on the tongue compared to the floor of the mouth, the only two sites explored in these studies.<sup>24,27,29,31</sup>

With regard to attitude domain, DHs feel that knowledge learned during under graduation training has been inadequate to do screening for OC<sup>21,26,27,29,30</sup>; however, a large number of DHs have stated that they know their role in the OC prevention.<sup>21,22,25,27,31-33</sup> To achieve this goal, almost all DHs want further education on OC and they argue for the need of CE.<sup>21,26,27,29</sup>

The third domain investigated in this systematic review is practice, both history taking and physical examination. The items regarding history-taking were reported only in few studies showing that a high percentage of DHs ask about tobacco use and a slightly lower percentage about alcohol consumption.<sup>22,23,25,26,28,31</sup> Finally, about physical examination, the majority of DHs are more confident to perform intraoral and extraoral examination less than palpation of lymph nodes.<sup>20-22,25,27,29,31-33</sup> DHs should be as confident as possible to perform the correct execution of screening programme, a pivotal step in early detection. It involves an oral examination with the objective of identifying changes, which may precede or predict, with a high likelihood, the development of the disease. Therefore, it is imperative for them to be familiar and comfortable with providing screening examination and to inform patients regarding the risk factors and lifestyle habits related to increased risk for cancer.

DHs play an important role in the primary and secondary prevention of oral diseases not only for the capability of detecting oral lesions deemed to be at highest risk and oral cancer, but also of

counselling and educating patients to avoid known risk factors. An appropriate treatment and lower stage at diagnosis have been most often associated with a non-symptom-driven examination, which was most likely to occur in a dental setting.<sup>12,43</sup> Even by detecting a malignant lesion in the early stage and educating their patients about the signs and risk factors associated with OC, they can positively influence mortality rates.<sup>44</sup>

The present study has, however, some limitations: first, the few online databases consulted; second, the lack of reliable questionnaires to assess knowledge, attitude and practice of DHs towards OC; third, most of the studies are focused on the knowledge domain and only few on the attitude and practice domains; finally, the poor quality of the selected studies. Moreover, the research protocol has not been registered on any of the current databases for systematic reviews (ie International Prospecting Register of Systematic Reviews (PROSPERO) or the Systematic Review Register of the Joanna Briggs Institute (JBI)).

DHs can be defined 'prevention specialists' through the services they provide including screening examinations, preventive treatments and oral health education, thus they represent a unique group of oral health care providers. In despite of DHs' key role, important practice and professional barriers (eg lack of self-efficacy, training and resources) remain among this population of oral healthcare providers. This systematic review highlights the importance of conducting surveys among DHs in order to identify the areas where the need for educational support is most evident. On several key aspects of OC risks, dental hygienists were seriously uninformed, such as about the role of sun exposure and HPV in cancer onset. In addition, most DHs consider their undergraduate training inadequate. Thus, misinformation among DHs can be attributed to gaps in the dental school

cancer curricula and to the absence of mandatory continuing education programmes. Gaps in knowledge of OC and its risk factors are important barriers in effective prevention and treatment. What this means is that education must be implemented and public health efforts should facilitate opportunities for education interventions among DHs, in order to reduce oral cancers morbidity and mortality.

## 5 | CLINICAL RELEVANCE

### 5.1 | Scientific rationale for study

The global spread of oral cancer has changed little over time. Despite the improvement in diagnostic and therapeutic techniques, the prognostic data have not changed significantly in the last 10 years, highlighting an alarming disparity between scientific progress and survival rate. KAP surveys among clinicians are the best way to assess health care delivery.

### 5.2 | Principal findings

Lack of KAP is identified among dental hygienists. They showed a good level of knowledge on most common risk factors. Most dental hygienists report being uncomfortable inspecting the oral cavity mainly due to inadequate training during the course of study:

### 5.3 | Practical implications

These data represent an important medical issue. This systematic review highlights the need to implement continuing education programmes pre- and post-graduation in order to improve the early detection and thus improving patient survival rates and reducing the negative economic impact on health systems.

#### ACKNOWLEDGEMENTS

Open Access Funding provided by Università degli Studi di Napoli Federico II within the CRUI-CARE Agreement. [Correction added on 29 May 2022, after first online publication: CRUI funding statement has been added.]

#### CONFLICT OF INTEREST

The authors declare no conflict of interest.

#### AUTHOR CONTRIBUTIONS

Coppola N. and Leuci S involved in the conceptualization. Blasi A and Baldares S involved in the methodology. Blasi A. and Ferrigno R. provided the software. Mignogna M.D. and Leuci S. involved in validation. Blasi A. and Ferrigno R. involved in formal analysis. Riviaccio I. S. and Coppola N. involved in the investigation. Coppola N and Ferrigno R. involved in the resourcing process. Blasi A. and Baldares S. cured the data. Coppola N, Riviaccio I. and Leuci S wrote the original draft.

Writing – Review & Editing, Leuci S. and Mignogna M.D. involved in writing—reviewed and edited. Mignogna M.D. involved in visualization. Leuci S. and Mignogna M.D. supervised the work. All authors gave final approval and agree to be accountable for all aspects of the work in ensuring that questions relating to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

#### ETHICAL APPROVAL

Not applicable.

#### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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**How to cite this article:** Coppola N, Rivieccio I, Blasi A, et al. Current knowledge, attitude and practice among dental hygienists in oral cancer awareness: Systematic review. *Int J Dent Hygiene*. 2022;20:249–261. doi:[10.1111/idh.12575](https://doi.org/10.1111/idh.12575)