Review

Medical practitioners’ educational competence about oral and oropharyngeal carcinoma: a systematic review and meta-analysis

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Abstract

Medical practitioners’ (MP) role is pivotal in primary prevention, early diagnosis, prompt referral and effective management of oral and oropharyngeal carcinomas (OC/OPC), which raises the importance of their effective OC/OPC education at all levels of medical education. The purpose of this systematic review was to summarise the available scientific evidence about their educational competence in dealing with OC/OPC. We made a systematic search of papers in the English language in MEDLINE, Scopus, Cochrane Library CENTRAL and CINAHL databases from their inception until December 2018. Overall, 23 cross-sectional and three interventional studies have been selected for the systematic review and 18 of these were included in the meta-analyses. Excluding tobacco use (synthesised estimate of 95% of respondents identified tobacco as an OC/OPC risk factor, 95% CI of synthesised estimate 92% to 97%) and alcohol consumption (65%, 95%CI 52% to 77%), less than half of MP (approximately) were knowledgeable about important OC/OPC risk factors including human papilloma virus (42%, 95% CI 30% to 54%), poor diet (34%, 95% CI 17% to 54%), and advancing age (45%, 95% CI 21% to 70%). There was a low to moderate level of awareness among MP regarding common precancerous oral lesions involving leukoplakia (56%, 95% CI 32% to 79%), erythroplakia (30%, 95% CI 8% to 58%), and oral lichen planus (13%, 95% CI 0 to 41%). Moderate knowledge was also recorded about frequent sites of OC development involving the tongue (48%, 95% CI 33% to 64%) and floor of the mouth (37%, 95% CI 19% to 57%). Most MP enquired about tobacco use (86%, 95% CI 74% to 96%), and alcohol consumption (73%, 95% CI 47% to 94%) during history taking, and expressed willingness to be given supplementary OC/OPC education (78%, 95% CI 54% to 96%), as well. With regard to the incidence of intraoral screening, 27% of MP (95% CI 12% to 46%) make an intraoral examination as a routine. Interestingly, studies from each continent yielded significantly different outcomes to some research questions in the review. From the MP’s perspective, clinical time restrictions and deficiencies in organised training were recognised as the main barriers towards their OC/OPC educational competence. The findings of this systematic review indicated the existence of deficiencies in knowledge and misconceptions, neglected preventive responsibilities, and associated barriers towards OC/OPC. A need for improved OC/OPC training at all levels of medical education is required to increase competence worldwide.

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Keywords: knowledge; attitudes; practices; medical practitioners; oral cancer; oropharyngeal cancer

Introduction

According to the official report of Global Cancer Statistics (GLOBOCAN) about the incidence and mortality estimates for 2018, the incidence of lip, oral, and oropharyngeal car-
cinomas (OC/OPC) is increasing rapidly worldwide.\(^1\) That report advocates that OC ranks eleventh among the most common cancers in men and, compared with major cancers, features one of the most dismal prognoses based on mortality.\(^1\) Similarly, the first consolidated report of the International Agency for Research on Cancer (IARC) supports the view that, compared with the 2012 prevalence, the global incidence of lip and OC/OPC is predicted to increase substantially (by 65% in 2035 with 856 000 incident cases) as a result of demographic alterations.\(^2\) Additionally, considering the American Cancer Society’s most recent estimates for OC/OPC in the USA for 2019, about 53 000 people will develop OC or OPC, citing an estimated number of 10 860 people who are expected to die of these cancers.\(^3\) Lip carcinomas and OC are common in Southern Asia and the Pacific Islands, while they are the leading cause of cancer death among men in India and Sri Lanka.\(^4\)

The surgical treatment of OC/OPC can result in dramatic aesthetic and functional outcomes, which alter considerably and adversely affect the patient’s quality of life.\(^4,5\) It is likely that patients subjected to surgical treatment will have considerable impairment in speech; swallowing difficulties; deterioration in the cosmetic appearance or disfigurement; disturbances in sensory function and chronic pain. The latter eventually may compromise patients’ mental health.\(^4,5\)

As detection of OC/OPC at an early stage improves survival, the role of medical practitioners (MP) is undoubtedly pivotal in surveillance. They can be the first point of contact in case of oral cavity lesions that require accurate diagnosis, prompt referral, and effective management. Indeed, patients at high risk of OC/OPC (including those with histories of tobacco smoking, or excess alcohol consumption, or both, and elderly patients) are more likely to present to their general MP (GMP) than their dental practitioner (DP) and, considering that the dental services are not affordable for low-income patients in many countries, the at-risk population is more likely to visit a physician or GMP than a dentist.\(^6,7\)

It is critical therefore, for MP to be sufficiently knowledgeable about the OC/OPC diagnostic process, the conduct of proper physical examination of the head and neck, and being well-informed about the signs and symptoms of premalignant and malignant lesions and treatment choices as well. It has been shown that deficits in GMP knowledge about OC/OPC lead to delays in referral and treatment.\(^8,9\) Consequently, for the sake of prevention, MP should possess an extensive knowledge of the OC/OPC risk factors and premalignant and malignant lesions, and should also adopt positive attitudes and practices as far as head and neck physical examinations are concerned, punctual referral to the appropriate experts, and continuing educational activities in this field.

It is likely that MP have received insufficient OC/OPC training during their formal undergraduate education. In healthcare, it has been recommended that surveys of knowledge, attitude, and practice (KAP) aim to gauge what healthcare providers know about a certain topic or concept, how they feel about it, and how they behave towards it.\(^10\) KAP also surveys elaborate barriers that may impede both modification of behaviour and activities that should be implemented.\(^10\) The purpose of this systematic review therefore was to investigate the competence of MP in terms of their amount of knowledge, skills, attitudes, perceptions, practices, and behaviours towards OC/OPC, and we then made a meta-analysis.

Material and methods

This systematic review relied on both Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (PRISMA) and increasing transparency in reporting the synthesis of qualitative research (ENTREQ) approaches.\(^11,12\) To structure the research questions of this systematic review, SPIDER (Sample, Phenomenon of Interest, Design, Evaluation and Research Type) and PICO (Patient, Intervention, Comparison, Outcome) tools were used to identify the qualitative, quantitative, and mixed-methods research on this topic (Appendix Table 1).\(^13\)

Data sources and search strategy

An extensive electronic search was made by two authors independently (SP and IP) of MEDLINE/Pubmed, Scopus, CINAHL, and the Cochrane Library databases from their inception until December 2018. A specific list of keywords was initially formulated and used in different combinations complying with the SPIDER and PICO tools. A supplementary hand-search was made of the reference list of the full-text articles that were finally included and articles not yet selected were also integrated (Appendix, Table 2).

Study selection

Consistent with the purpose of this systematic review, a SPIDER research question was formulated including “What is the educational competence (D) of MP (S) concerning OC/OPC (P) and/or (I)?”. To identify the impact of educational interventions on MP practitioners OC/OPC education competence, a PICO question was generated, namely “What is the effect of an educational method (I) on MP (P) education competence (O) concerning OC/OPC?” To address the SPIDER research question of the systematic review, cross-sectional studies investigating the current knowledge status and/or skills and/or attitudes and/or perceptions and/or practices, and/or behaviours of MPs concerning OC/OPC were eligible for inclusion. In answer of the PICO question, intervention studies examining MP knowledge status, or skills, or attitudes, or perceptions, or practices, or behaviours (or all of them) before and after MP exposure to a specific educational method relative to OC/OPC were appropriate for full-text reading. The authors (SP, IP) first scrutinised the titles, the
Table 1
Selection inclusion and exclusion criteria.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Inclusion</th>
<th>Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>English</td>
<td>Non-English</td>
</tr>
<tr>
<td>Study focus</td>
<td>Studies investigating the knowledge AND/OR attitudes AND/OR practices/behaviours of MPs towards oral health topics (SPIDER question)</td>
<td>Studies investigating the OC/OPC knowledge AND/OR attitudes AND/OR practices of medical students</td>
</tr>
<tr>
<td></td>
<td>Studies investigating the impact of OC/OPC educational interventions on MPs’ knowledge AND/OR attitudes AND/OR practices/behaviours (PICO question)</td>
<td>Studies investigating the knowledge AND/OR attitudes AND/OR practices of MPs towards other oral health related topics</td>
</tr>
<tr>
<td>Sample (S)</td>
<td>Medical practitioners -specialised or not, trainees or residents-</td>
<td>Medical students</td>
</tr>
<tr>
<td>Phenomenon of interest (PI)</td>
<td>OC/OPC issues</td>
<td>Other health care practitioners</td>
</tr>
<tr>
<td>Educational intervention (I)</td>
<td>Clear description of educational intervention</td>
<td>Non OC/OPC topics</td>
</tr>
<tr>
<td>Research design (D)</td>
<td>Cross-sectional studies/ Comparative cross-sectional studies/ Randomised clinical trials (RCTs), Non-RCTs</td>
<td>Reviews, opinion-based studies, letter to editors, case reports, study protocols, intervention studies</td>
</tr>
<tr>
<td>Evaluation (E)</td>
<td>MPs’ knowledge status/skills/attitudes/perceptions/views/opinions/practices/behaviours</td>
<td>Unrelated with MPs’ knowledge status/skills/attitudes/perceptions/views/opinions/practices/behaviours</td>
</tr>
<tr>
<td>Research type (R)</td>
<td>Qualitative studies, quantitative studies, and mixed-method studies</td>
<td>–</td>
</tr>
<tr>
<td>Research instrument</td>
<td>Clear report of the research instrument; questionnaire, interview, focus group, survey</td>
<td>No report of the research instrument</td>
</tr>
<tr>
<td>Geographical area of interest</td>
<td>Worldwide</td>
<td>–</td>
</tr>
<tr>
<td>Setting</td>
<td>No limitation</td>
<td>–</td>
</tr>
</tbody>
</table>

abstracts, and the keywords of the initially collected articles, and then evaluated their appropriateness for full-text reading, eliminating the number of irrelevant studies. Only if defined inclusion criteria were met was the article eventually included (Table 1). In the event of any emerging disagreement among the authors, titles were included to examine full texts and consensus reached after discussion. Overall, a 100% agreement rate was eventually obtained between the two reviewers.

**Data extraction**

Among the data items that were recorded on the data extraction sheet within each included study were the authors’ names, year of publication, purpose of study, participants’ country of origin, sample size, medical specialty, the research instrument, and the outcomes in percentages relative to participants’ knowledge, skills, attitudes, perceptions, practices, and behaviours about oral health issues.

**Data synthesis**

A thematic approach was used to analyse MP oral health education competence towards OC/OPC. The research workers (SP and IP) independently initially recorded and classified the data arising from questionnaires and survey of MP responses into three distinct domains, including OC/OPC prevention, diagnosis, and management. These were further subdivided into the following themed categories; OC/OPC risk factors, precancerous oral lesions, common OC intraoral sites, history taking, clinical presentation and characteristics, intraoral screening and physical examination, patients’ consultation, referral pathways, and treatment.

Meta-analyses were made, whenever applicable, to assess the extent of MP educational competence on the above themed categories. All outcomes were dichotomous, expressed as proportions of the sample that: a) identified particular knowledge statements involving OC/OPC risk factors, precancerous oral lesions, common OC/OPC intraoral sites, OC/OPC clinical presentation and characteristics, intraoral screening, and physical examination; b) expressed attitudes/views/opinions/perceptions regarding history taking, intraoral screening and physical examination, OC/OPC training; and c) specified practices/behaviours about intraoral screening, physical examination and patients’ consultation. In the event of Likert scale study questions, we modified the results to a binary method integrating “very much” with “much” as well as “little” with “not at all” responses. Additionally, both “do not know” and “neutral” response categories were excluded. When the study involved a group of MP from different specialties, a mean of the reported frequencies was calculated, to be included in the results section.

Because the questions were not exactly similar among the different studies, the information consistent with the purpose of this study was extracted. Eventually, 21 knowledge statements, five attitudes items, and four practices statements that grouped questions and were common among the different studies were considered as the outcomes for the meta-analyses.

In particular, the included knowledge questions consisted of seven statements about OC/OPC risk factors, three about precancerous lesions, four relative to common intraoral sites for OC/OPC development, five regarding clinical presentation and characteristics of OC, and two about the intraoral screening and physical examination:

A Tobacco use is a risk factor for OC/OPC (K)
B Alcohol consumption is a risk factor for OC/OPC (K)
C Human papilloma virus is a risk factor for OC/OPC (K)
D Advancing age is a risk factor for OC/OPC (K)
E Poor diet is a risk factor for OC/OPC (K)
F Sun exposure is a risk factor for lip cancer (K)
G History of previous oral and maxillofacial malignancy is a risk factor for OC/OPC (K)
H Leukoplakia is a precancerous oral lesion (K)
I Erythroplakia is a precancerous oral lesion (K)
J Oral lichen planus represents a precancerous oral lesion (K)
K Floor of the mouth is a common intraoral location for OC development (K)
L Lips are common sites for carcinoma development (K)
M Ventral-lateral surface of the tongue is a common intraoral location for OC development (K)
N Tongue is a common intraoral location for OC development (K)
O Early OC lesions have asymptomatic character and appearance (K)
P Ulceration can be an early OC presentation (K)
Q Early oral cancer lesions usually appear as small, painless red area (K)
R Early oral cancer lesion can usually appear as white patch (K)
S Squamous carcinoma is the most common histologic type of OC/OPC (K)
T The intraoral examination must involve inspection of posterior dorsum of the tongue (K)
U OC/OPC metastasis involves painless, hard, painless, mobile or fixed lymph nodes (K)

With regard to the attitudes items, two questions were associated with the MP perceived level of adequacy about patient’s consultation during history taking, two questions were related to the clinical examination, and one statement was about the MP willingness for further education/training on OC/OPC, namely:

A I want further education/training on OC/OPC (A)
B I feel confident to detect oral malignancy (A)
C I am adequately trained to examine patients OC/OPC (A)
D I am adequately trained to provide tobacco cessation education (A)
E I am adequately trained to provide alcohol cessation education (A)

Finally, the practice statements involved statements about history taking, intraoral screening, and physical examination. These were:

A I ask about tobacco use during history taking (P)
B I ask about alcohol consumption during history taking (P)
C I perform intraoral examination on a routine basis (P)
D I palpate the cervical lymph nodes on a routine basis (P)

**Statistical analysis**

Proportion meta-analyses were made using MetaXL statistical software (version 3.3) on all the studies that yielded comparable outcomes. Heterogeneity of the studies was evaluated using Cochrane’s Q test and the $I^2$ statistics. A random effects model was used to combine studies that showed heterogeneity of Cochrane Q p < 0.10, and $I^2 > 50\%$. A forest plot together with a synthesised estimate (and associated 95% CI) were calculated using DerSimonian & Laird weightings, and tabulated summaries of proportions of positive events experienced in each question/statement are presented. The chi squared test of independence was also used to identify significant differences in the sample proportions of studies originated from different continents. Probabilities of less than 0.05 were considered significant. Statistics were analysed using IBM SPSS Statistics (version 22.0, IBM Corp.). Tests for funnel plot asymmetry were done only in questions where at least 10 studies were included in the meta-analysis, because when there are fewer studies the power of the tests is too low to distinguish chance from real asymmetry.

**Quality Assessment**

The methodological quality of the studies was assessed according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) scale. Studies of high quality (that met over 75% of the STROBE checklist criteria) were used for the meta-analysis. To address the issue of heterogeneity among studies, a sensitivity analysis was made relative to studies conducted in different continents.

To assess whether or not publication bias was present, statistical analyses were made through funnel and Doi plots (a symmetrical mountain-like plot) with the Luis Furuya-Kanamori (LFK) index by which $< 1$ indicates no asymmetry, LFK index between 1 and 2 suggests minor asymmetry, and LFK index > 2 suggests major asymmetry.

**Results**

**Literature search and selection results**

The electronic search provided a total of 6584 abstracts that were considered potentially relevant. After removal of duplicates and in compliance with the study protocol, a detailed screening of the titles and abstracts of the manuscripts was made that resulted in full-text reading of 30 articles (Fig. 1). Eventually, considering the predefined inclusion criteria, 26 papers were included in the final set of included studies (Appendix Table 3). On the basis of the study design, 21 cross-sectional studies aimed to investigate the MP knowledge status or skills, attitudes/perceptions and practices/behaviours towards OC/OPC quantitatively through questionnaires. Additionally, five studies explored MP educational competence qualitatively through interviews and focus groups. Finally,
three intervention studies were detected that explored MP knowledge skills, attitudes/perceptions and practices/behaviours towards OC/OPC after their exposure to an educational activity.

With regard to the participants’ specialty, eight studies involved GMP, six involved primary care physicians (PCP) five included physicians, two studies included family physicians, one study entailed otorhinolaryngologists, one study involved internists, two studies included dermatologists and one study involved radiation oncologists. Finally, 11 studies were conducted in the USA, five in Asia, eight in Europe, and one in Canada.

Four cross-sectional studies were excluded from the meta-analysis and included in the systematic review only because percentages of MP response were not available. All 18 studies selected for the meta-analysis followed the most important requirements, meeting >75% of the STROBE scale criteria (Tables 2 and 3, Appendix Table 3). However, most of the included studies did not cover all the research questions or statements.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Specialty</th>
<th>Origin</th>
<th>Risk factors</th>
<th>Precancerous lesions</th>
<th>Clinical picture</th>
<th>Common sites of development</th>
<th>Physical examination</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alami et al, 2012</td>
<td>57 MPs</td>
<td>Amman, Jordan</td>
<td>Tobacco; 90% Alcohol; 60% Advancing age; 40%–50% Sun exposure; 10%–20% Low consumption of fruits/vegetables; 20%–30% HPV; 20%</td>
<td>Leukoplakia; 64.9% Nicotinic stomatitis; 12.3% Erythroplakia; 17.5% Lichen planus; 12.3% Leukoerythroplakia</td>
<td>Small painless red or white area; 89.1% Lymph node characteristic of oral cancer metastasis; hard painless mobile or fixed; 92.9% Squamous cell carcinoma most common OC histologic type; 89.3%</td>
<td>Tongue; 22.8% Floor of the mouth; 33.3% Lips; 42.1% Ventral area tongue; 31.6% Lateral area tongue</td>
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<tr>
<td>Applebaum et al, 2009</td>
<td>118 PCPs</td>
<td>Massachusetts, USA</td>
<td>Tobacco; 83.3% Alcohol; 35% Sun exposure; 55.5% Oral malignancy history; 99.2%</td>
<td>Leukoplakia; 10% Erythroplakia; 10%</td>
<td>Leukoplakia; 10.4% Erythroplakia; 10.4%</td>
<td>Small painless red area; 57% Asymptomatic in early OC stage; 71.3% Lymph node characteristic of OC metastasis; hard painless mobile or fixed; 86.1% Squamous cell carcinoma most common OC histologic type; 80%;</td>
<td>Tongue; 66.7% Floor of the mouth; 10.6% Lips; 20.6% Tongue &amp; Floor of the mouth; 25.4% Ventral lateral border of tongue; 35.4%</td>
<td>Sticking out tongue/Posterior dorsum; 90.7%</td>
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<tr>
<td>Borhan-Mojabi et al, 2011</td>
<td>66 GMPs</td>
<td>Qazvin, Iran</td>
<td>Tobacco; 100% Alcohol; 89.3% Advancing age; 42% Low consumption of fruits/vegetables; 29.5% Sun exposure; 55.5% Oral malignancy history; 99.2%</td>
<td>Leukoplakia; 10.4% Erythroplakia; 10.4%</td>
<td>Leukoplakia; 10.4% Erythroplakia; 10.4%</td>
<td>Small painless red area; 57% Asymptomatic in early OC stage; 71.3% Lymph node characteristic of OC metastasis; hard painless mobile or fixed; 86.1% Squamous cell carcinoma most common OC histologic type; 80%;</td>
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<td>Sticking out tongue/Posterior dorsum; 90.7%</td>
</tr>
<tr>
<td>Canto et al, 2002</td>
<td>240 FMPs</td>
<td>Maryland, USA</td>
<td>Tobacco; 100% Alcohol; 89.3% Advancing age; 42% Low consumption of fruits/vegetables; 29.5% Sun exposure; 55.5% Oral malignancy history; 99.2%</td>
<td>Leukoplakia; 10.4% Erythroplakia; 10.4%</td>
<td>Leukoplakia; 10.4% Erythroplakia; 10.4%</td>
<td>Small painless red area; 57% Asymptomatic in early OC stage; 71.3% Lymph node characteristic of OC metastasis; hard painless mobile or fixed; 86.1% Squamous cell carcinoma most common OC histologic type; 80%;</td>
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<td>Sticking out tongue/Posterior dorsum; 90.7%</td>
</tr>
<tr>
<td>Carter et al, 2007</td>
<td>238 GMPs</td>
<td>Tayside, United Kingdom</td>
<td>Tobacco &gt;90% Alcohol; 43.3% Dietary factors &lt;10% Malignancy history &lt;10% Tobacco; 90.7% Alcohol; 45.7%</td>
<td>Leukoerythroplakia; 0%</td>
<td>Leukoerythroplakia; 0%</td>
<td>Leukoerythroplakia; 0%</td>
<td>White patch; 50% Red patch; 5% Ulceration; 75% Induration; &lt;10%</td>
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<tr>
<td>Greenwood and Lowry, 2001</td>
<td>151 GMPs</td>
<td>North East of England</td>
<td>Tobacco 90.7% Alcohol; 45.7%</td>
<td>–</td>
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<td>–</td>
<td>–</td>
<td>S.R 64.9% S.R + Chemo 32.5%</td>
</tr>
<tr>
<td>Hassona et al, 2015</td>
<td>165 primary HCPs (MPs)</td>
<td>Jordan</td>
<td>Tobacco; 96.7% Alcohol; 57.3% Advancing age; 37.3% Sun exposure; 24.2% HPV; 43.3% Malignancy history; 73.6% Poor diet; 26.7% Prolonged immunosuppression; 30.3%</td>
<td>Leukoerythroplakia; 64.4% Erythroplakia; 44.2% Chronic hyperplastic candidiosis; 39.7% Lichen Planus/lichenoid lesions; 33.2% Actinic cheilitis; 17.9% Submucous fibrosis; 15.5%</td>
<td>Leukoerythroplakia; 64.4% Erythroplakia; 44.2% Chronic hyperplastic candidiosis; 39.7% Lichen Planus/lichenoid lesions; 33.2% Actinic cheilitis; 17.9% Submucous fibrosis; 15.5%</td>
<td>White patch; 46.4% Red patch; 42.4% Enlarged lymph nodes; 71.8 %</td>
<td>Ulcerated lump; 67.6% Limited tongue mobility/dysphagia; 67.3% Pain; 65.2% Delayed healing of extraction sites; 43%</td>
<td>Scalpel biopsy; N/R Exfoliative cytology; 51.5% Brush biopsy: 35.8% Fluorescent lights; 27% Toluidine blue; 20.9%</td>
</tr>
<tr>
<td>Study</td>
<td>Setting</td>
<td>Sample Size</td>
<td>Risk Factors</td>
<td>Lesion Characteristics</td>
<td>Stage Diagnosis</td>
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<tr>
<td>Hertrampf et al, 2014&lt;sup&gt;1&lt;/sup&gt;</td>
<td>33 otolaryngologists, 135 internists, 28 dermatologists, 192 GMPs</td>
<td>Schleswig-Holstein state, Germany</td>
<td>Tobacco: 93%–100% Alcohol: 79%–100% Advancing age: 67%–78% Low consumption of fruits/vegetables: 18%–40% HPV: 50%–82% Sun exposure: 44%–96% Malignancy history: 91%–100%</td>
<td>Leukoplakia &amp; Erythroplakia: 82%–91% Asymptomatic character: 27%–82% and appearance: 21%–50% Malignant lymph node characteristic: 79%–94% OC diagnosis at advanced stages: 81%–90% Squamous cell carcinoma is the most common histologic type of OC: 75%–93%</td>
<td>Tongue: 52%–67% Floor of the mouth: 67%–75% Ventral-lateral border of the tongue: 39%–82%</td>
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<tr>
<td>Macpherson et al, 2003&lt;sup&gt;2&lt;/sup&gt;</td>
<td>198 GMPs</td>
<td>Glasgow, Ireland</td>
<td>Tobacco: 97% Alcohol: 79% Advancing age: 76% Trauma: 43% Viral infections: 23%</td>
<td>Leukoplakia: 72% Erythroplakia: 22%</td>
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<tr>
<td>Ni Riordain and McCreaey, 2009&lt;sup&gt;3&lt;/sup&gt;</td>
<td>221 physicians</td>
<td>Ireland</td>
<td>Tobacco: 98.7% Alcohol: 50.8% Advancing age: 12.5%</td>
<td>Leukoplakia: 12.7% Erythroplakia: 0.4% Oral lichen planus: 1.2%</td>
<td>Ulceration: 67.4% Pain: 30.9% Swelling: 21.6% Lesion: 21.2% Lymphadenopathy: 16.5% Dysphagia: 16.5% Bleeding: 12.7% Lump: 12.7% Halitosis: 1.2% Cough: 0.8% Burning sensation: 0.8%</td>
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<tr>
<td>Nicotera et al, 2004&lt;sup&gt;4&lt;/sup&gt;</td>
<td>189 PCPs</td>
<td>Calabria, Italy</td>
<td>Tobacco: 87.6% Alcohol: 64% Advancing age: 2.8% Malignancy history: 31.5%</td>
<td>Leukoplakia: 91.5% Erythroplakia: 41.7%</td>
<td>Prior oral cancer lesion usually is small, painless, white or red area: 87.8% Early oral lesion as small, painless, red area: 17.6% Squamous-cell carcinoma is the most common form of OC: 60.9%</td>
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<tr>
<td>Reed et al, 2010&lt;sup&gt;5&lt;/sup&gt;</td>
<td>221 Physicians</td>
<td>South Carolina, USA</td>
<td>Tobacco: 88–98% Alcohol: 37%–46% Diet: 66% HPV: 45%</td>
<td>–</td>
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</tr>
<tr>
<td>Tanriover et al, 2013&lt;sup&gt;6&lt;/sup&gt;</td>
<td>164 PCPs</td>
<td>Istanbul, Turkey</td>
<td>Tobacco: 98.8% Alcohol: 89% Advancing age: 87.8% Low consumption of fruits/vegetables: 68.9% Malignancy history: 93.9% Sun exposure: 73.2%</td>
<td>Leukoplakia &amp; Erythroplakia: 84.1%</td>
<td>75.6% cited that squamous cell carcinoma is the most common form of OC Early diagnosis increases the 5-year survival rate (87.8%)</td>
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<tr>
<td>Shimpi et al, 2016&lt;sup&gt;7&lt;/sup&gt;</td>
<td>121 GMPs</td>
<td>Marshfield, USA</td>
<td>–</td>
<td>Leukoplakia: 65.30%</td>
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</table>
Table 3
Studies about MPs’ practices regarding OC/OPC. (PCPs; primary care physicians, GMPs; general medical practitioners, OMFS; oral and maxillofacial surgery, ENT; ear, nose and throat).

<table>
<thead>
<tr>
<th>Study</th>
<th>Specialty</th>
<th>Study Origin</th>
<th>Consultation (%)</th>
<th>History Taking</th>
<th>Physical examination</th>
<th>Referral (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canto et al, 2002¹⁰</td>
<td>240 Family physicians</td>
<td>Maryland, USA</td>
<td>–</td>
<td>77% ask for all eight questions associated with risk factors; patient’s past alcohol use/patient’s present alcohol use/type and amount of alcohol used/patient’s previous tobacco use, patient’s present tobacco use, type and amount of tobacco used/patient’s cancer history/family cancer history</td>
<td>15% performed OC examination at 100% of the time to patients over 40 years at their initial appointment</td>
<td>–</td>
</tr>
<tr>
<td>Carter et al, 2007²⁰</td>
<td>238 GMPs</td>
<td>Tayside, United Kingdom</td>
<td>Regular advising on the OC risk factors (N/R)</td>
<td>–</td>
<td>20.17% routinely examined patients’ oral mucosa</td>
<td>Referral to specialists in oral medicine and oral and maxillofacial surgery (N/R)</td>
</tr>
<tr>
<td>Hassona et al, 2015²²</td>
<td>165 primary HCPs (MPs)</td>
<td>Jordan</td>
<td>Provision routinely smoking cessation and alcohol moderation advice; 46.1 %</td>
<td>Asking always about smoking habits; 62.1 %</td>
<td>17.8% routinely performed oral OC 53% inspect mucosal surfaces of the oral cavity in case of a new patient 14.2% always perform palpation of oral mucosal surfaces 21.5% examine floor of the mouth/ventrolateral surfaces of the tongue and the retromolar trigone 33.6% inspect the oropharynx 32.7% palpate cervical lymph nodes</td>
<td>87.6% refer in the event of suspicious oral lesion 10.6% perform biopsy 0.9% follow wait and see method 0.9% try to treat the patient</td>
</tr>
<tr>
<td>Greenwood and Lowry, 2001²¹</td>
<td>151 GMPs</td>
<td>North East of England</td>
<td>–</td>
<td>–</td>
<td>68.2% examination of all sites equally versus specific sites</td>
<td>74.2% refer to OMFS specialists-</td>
</tr>
<tr>
<td>McCunniff et al, 2000²⁶</td>
<td>77 PCPs</td>
<td>Missouri-Kansas City, USA</td>
<td>–</td>
<td>–</td>
<td>7% examine 100% of their patients for OPCs 65.3% regularly examine the oral mucosa; almost half of them in the event of pain in this area or patient’s request for oral examination</td>
<td>–</td>
</tr>
<tr>
<td>Ni Riordain and McCreary, 2009²⁷</td>
<td>221 physicians</td>
<td>Ireland</td>
<td>–</td>
<td>–</td>
<td>37.7 % referred their patients to ENT specialists 18.6% referred to OMFS 25.4% to Oral medicine experts -</td>
<td>–</td>
</tr>
<tr>
<td>Study</td>
<td>Number of Physicians</td>
<td>Location</td>
<td>Screening Procedure</td>
<td>Details</td>
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<tr>
<td>Nicotera et al., 2004</td>
<td>189 PCPs</td>
<td>Calabria, Italy</td>
<td>–</td>
<td>52.9% asked about OC patient’s experience; 48.1% asked about the patient’s family OC history; 85.1% asked about patients’ tobacco products use; 82.5% asked about patients’ alcohol use.</td>
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<tr>
<td>Patton et al., 2006</td>
<td>273 Family physicians</td>
<td>North Carolina USA</td>
<td>–</td>
<td>63.8% performed OC screening procedure; 37.1% provided OC screening for patients over 40 years.</td>
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<tr>
<td>Reed et al., 2010</td>
<td>221 Physicians</td>
<td>South Carolina, USA</td>
<td>–</td>
<td>90% asked about present tobacco use and cancer history; Over 90% asked about past, present, amount and type of alcohol use.</td>
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<tr>
<td>Tanriover et al., 2013</td>
<td>164 PCPs</td>
<td>Istanbul, Turkey</td>
<td>–</td>
<td>79.3% always ask about the current smoking status / 78% always about past smoking status / 70.1% about the amount of tobacco use / 59.1% always ask about current alcohol consumption / 54.3% about past alcohol consumption / 43.3% about the amount of alcohol consumed.</td>
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<tr>
<td>Yellowitz et al, 1995</td>
<td>93 Physicians</td>
<td>Maryland USA</td>
<td>–</td>
<td>34.8% did not perform OC examinations in patients over 40 years; 19.5% referred their patients to an ENT; 1.2% referred the patients to plastic surgery and oncology; 0.6% referred to dermatologists.</td>
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<tr>
<td>Study</td>
<td>Specialty</td>
<td>Study Origin</td>
<td>Consultation (%)</td>
<td>History Taking</td>
<td>Physical examination</td>
<td>Referral (%)</td>
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<tr>
<td>Heelan et al, 2016&lt;sup&gt;36&lt;/sup&gt;</td>
<td>95 dermatologists</td>
<td>United Kingdom/Ireland</td>
<td>–</td>
<td>–</td>
<td>90% do not routinely perform an oral examination</td>
<td>74% would refer to general hospitals; 83% of them would choose OMFS specialists and 15% would choose ENT</td>
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<td>92% perform an oral examination if indicated by the history or skin examination</td>
<td>22% would refer a dental hospital</td>
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<td>62% do not use a defined method or sequence for the assessment</td>
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<td>55.5% tend to examine both the intra and extraoral regions</td>
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<td>94% performed intraoral examination in response to a complaint of soreness and 81% in case of pre-existing oral condition</td>
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<td></td>
<td>62% do not use a defined method or sequence for the assessment</td>
<td></td>
</tr>
<tr>
<td>Macpherson et al, 2003&lt;sup&gt;25&lt;/sup&gt;</td>
<td>198 GMPs</td>
<td>Glasgow/Ireland</td>
<td>–</td>
<td>87% enquired about their patients’ smoking habits, 67% asked routinely about alcohol consumption.</td>
<td>74% would refer to general hospitals; 83% of them would choose OMFS specialists and 15% would choose ENT</td>
<td></td>
</tr>
<tr>
<td>Borhan-Mojabi et al, 2011&lt;sup&gt;18&lt;/sup&gt;</td>
<td>66 GMPs</td>
<td>Qazvin, Iran</td>
<td>–</td>
<td>–</td>
<td>39.4% routinely examined the mucous membrane of the mouth</td>
<td>59.1% referred their patients to ENT specialists</td>
</tr>
</tbody>
</table>
Prevention

Risk factors

Knowledge: Among the included articles, 12 cross-sectional studies explored MP knowledge about OC/OPC risk factors. In particular, 95% of MP indicated tobacco use (95% CI 92% to 97%, p < 0.001, $I^2 = 89%$) and alcohol consumption (95% CI 52% to 77%, p < 0.001, $I^2 = 98%$), 45% advancing age (95% CI 21% to 70%, p < 0.001, $I^2 = 99%$), 34% poor diet (95% CI 17% to 54%, p < 0.001, $I^2 = 98%$), 70% history of malignancy (95% CI 29% to 100%; p < 0.001, $I^2 = 100%$), 42% human papilloma virus (HPV) infection (95% CI 30% to 54%, p < 0.001, $I^2 = 91%$), and 44% exposure to sun (95% CI 26% to 62%, p < 0.001, $I^2 = 97%$). (Figs. 2 and 3)

Intervention studies: Following a web-based education module with poster reminders of OC physical examination, the RCT by Wee et al reported a significant improvement in the knowledge of OC risk factors after a two-week time period (Table 4). 39

History-taking

Attitudes: In the USA, 91% of family physicians (95% CI 85% to 96%, p < 0.001, $I^2 = 77%$) felt adequately trained to provide counselling on tobacco cessation, 79% felt adequately trained to provide counselling on alcohol cessation (95% CI 74% to 83%, p < 0.001, $I^2 = 47%$) and 62% (95% CI 57% to 66%, p < 0.001, $I^2 = 0%$) felt adequately trained to examine patients for OC/OPC (Fig. 9).

Practices: During history taking, 86% of MPs enquired about tobacco use (95% CI 74% to 96%, p < 0.001, $I^2 = 98%$) and 74% about alcohol consumption (95% CI 47%–94%, p < 0.001, $I^2 = 99%$) (Fig. 8).

Intraoral screening and physical examination

Practices: Among the available scientific evidence, 27% of MP (95% CI 12% to 46%, p < 0.001, $I^2 = 98%$) used intraoral screening as a routine part of their clinical practice. Based on two studies, cervical lymph nodes were palpated by 38% of MP (95% CI 28% to 48%, p < 0.001, $I^2 = 77%$).

Intervention studies: The study by Mowat et al showed that after an interprofessional educational programme, all the Readiness for Interprofessional Learning Scale (RIPLS) domains increased significantly from before to after the event, with effects returning to the baseline measurements six months after the intervention. 39 No significant differences were seen in the incidence of patients’ screening regarding OC/OPC and precancerous lesions of the oral cavity after a six-month period after the intervention. Similarly, in the study by Wee et al, the attendance of the OC educational module resulted in a significant increase in the number of patients’ OC examinations made by PCP (Table 4). 39

Consultation

Practices/Behaviours: There is limited evidence about the incidence of preventive OC/OPC consultation; the study by Carter and Ogden cited that GMP provided regular advice on the OC risk factors, while 46.1% of primary HCP rou-
tinely provided advice on smoking cessation and alcohol moderation.20 In South Carolina, 29% of physicians indicated Medicaid reimbursement for nicotine replacement therapy, and 83% assisted smokers by advising or recommending medications aiding patients to quit smoking (Table 4).31

**Diagnosis**

**Precancerous oral lesions**  
**Knowledge:** Leukoplakia was rightly reported as a potential precancerous oral lesion by 56% of MP (95% CI 32% to 79%, p < 0.001, $I^2 = 99%$). Additionally, 30% of MP indicated erythroplakia as a potential premalignant lesion (95% CI 8% to 58%, p < 0.001, $I^2 = 99%$), and 13% identified oral lichen planus (95% CI 0% to 41%, p < 0.001, $I^2 = 98%$) (Fig. 4).

**Location**  
**Knowledge:** With regards to the OC/OPC intraoral location, 48% of MP indicated tongue (95% CI 33% to 64%, p < 0.001, $I^2 = 96%$), 32% the ventral-lateral areas of tongue (95% CI 26% to 39%, p < 0.001, $I^2 = 98%$),14,17,21,33 37% the floor of the mouth (95% CI 19% to 57%, p < 0.001, $I^2 = 97%$), and 40% lips (95% CI 31% to 49%, p < 0.001, $I^2 = 62%$) as common sites of cancer development (Fig. 5).

**Clinical picture**  
**Knowledge:** The asymptomatic character and appearance of early OC lesions was identified by 65% (95% CI 41% to 85%; p < 0.001, $I^2 = 97%$). The MP defined the clinical picture of OC, with 71% (95% CI 45% to 92%; p < 0.001, $I^2 = 96%$) reporting white patch area, 54% (95% CI 22% to 86%, p < 0.001, $I^2 = 100%$) a small, painless red area, 70% ulceration (95% CI 65% to 75%; p < 0.001, $I^2 = 51%$) and 86% (95% CI 82% to 90%, p < 0.001, $I^2 = 46%$) citing correctly the characteristics of malignant lymph nodes including enlarged, hard, painless, mobile, or fixed lymph nodes. Additionally, 77% of MP (95% CI 66% to 86%, p < 0.001, $I^2 = 89%$) acknowledged that squamous cell carcinoma is the most common histological type for OC/OPC (Figs. 6 and 7).

**Physical examination**  
**Knowledge:** In terms of the physical examination, 77% of MP (95% CI 45% to 98%, p < 0.001, $I^2 = 99%$) rightly reported that the process of intraoral clinical examination should involve sticking out the tongue and examination of the posterior dorsum (Fig. 7).

**Attitudes:** In Ireland, 34% of GMP (95% CI 13% to 58%, p < 0.001, $I^2 = 96%$), felt confident to detect premalignant or malignant oral lesions. (Fig. 10) In general, among the available studies 78% of MP (95% CI 54% to 96%, p < 0.001, $I^2 = 98%$), stated that they were willing to receive further education/training in OC diagnosis (Fig. 10).

**Intervention studies:** The RCT by Wee et al cited that a significant improvement in the knowledge score for OC diagnostic procedure occurred after a two-week time period (Table 4).39
Table 4
Intervention studies about MPs’ education competencies regarding OC/OPC.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Region/ Country</th>
<th>Type of study</th>
<th>Purpose</th>
<th>Participants</th>
<th>Educational intervention</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barker et al., 2001 \cite{37}</td>
<td>Missouri-Kansas City, USA</td>
<td>Cross-sectional pre- and post-intervention (3 months)</td>
<td>Improve OPC awareness among health practitioners</td>
<td>352 health practitioners</td>
<td>45-minute multi component educational intervention including a slide presentation, videotape, a one-page summary of critical factors about OPC</td>
<td>44% post-intervention response rate</td>
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<td>A statistically significant increase in total knowledge, from a mean baseline score of 19.7 to a mean post-intervention score of 21.5 was found (P &lt; .001)</td>
</tr>
<tr>
<td>Mowat et al., 2017 \cite{38}</td>
<td>Manitoba, Canada</td>
<td>Cross-sectional pre- and post-intervention (immediately and at 6 months)</td>
<td>Assessment of the impact of an interprofessional continuing education program regarding oral-systemic on health participants’ perceived attitudes about of teamwork and collaboration (TC)/ sense of professional identity (PI)/ and patient-centeredness (PC)</td>
<td>64 Physicians 15 DPs 41 Dental hygienists 11 Nurse or nurse practitioners</td>
<td>An interprofessional continuing education program dedicated to oral-systemic health involving roundtable discussions, morning lectures with related, case studies, and an optional workshop on performing an OC examination</td>
<td>RIPLS domains of teamwork and collaboration (TC), sense of professional identity (PI), and patient-centeredness (PC) using 23 five-point rating scale questions Total RIPLS score at baseline was 76.5, which increased significantly immediately following the program (81.0) but returned to baseline six months later (76.5). There were significant differences in the TC (pre H(3) = 19.040, P &lt; .001; post H(3) = 10.715, p = .013) and PI (pre H(3) = 11.644, p = .009; post H(3) = 9.809, P &lt; .020) domain score</td>
</tr>
<tr>
<td>Wee et al., 2016 \cite{39}</td>
<td>Nebraska, USA</td>
<td>Clustered RCT</td>
<td>Assessment of the effect of a web-based education program on PCPs’: a) index of knowledge of OC risk factors (RiskOC), b) index of knowledge of OC diagnostic procedures (DiagOC) and c) incidence of OC examination</td>
<td>18 PCPs (Physicians, physician assistants, nurses)</td>
<td>A poster with a 40-minute web-based educational program was entitled, “Importance of Conducting Routine Oral Cancer Examinations by Medical Practitioners” with poster reminders</td>
<td>Mean post-index of knowledge of OC diagnostic score: Mean ± SD 7.74 ± 0.67 9.78 ± 0.51 Mean post-index of knowledge of OC risk factors score: Mean ± SD 10.4 ± 0.79 11.8 ± 0.57 The post-DiagOC and post-RiskOC scores were higher for the PCPs in the intervention group clinics compared with scores from PCPs in the control group (P &lt; .001) The intervention was found to be a significant factor for the PCPs to perform patient OC examination</td>
</tr>
</tbody>
</table>

Management

Treatment

Knowledge: Only the study of Greenwood and Lowry examined the MP knowledge towards OC/OPC treatments; chemotherapy was cited as a possible treatment option for OC/OPC by 32.5% of GMP whereas surgery and radiotherapy were selected by 64.9% of GMP (Table 2).\cite{21}

Referral

Practices: Seven studies provided some evidence about the indicated referral pathways,\cite{18,20,22,25,27,52} according to Carter and Ogden, most GMP indicated the experts in oral medicine and OMFS as pertinent specialists for patients’ referral.\cite{21} Similarly, two studies that originated from the UK and Ireland reported that the majority of MP would refer patients with suspicious oral lesions to OMFS specialists.\cite{21,25} Based on four studies, the ENT specialists were also involved in the indicated referral pattern.\cite{18,25,27,32} In the event of a suspicious oral lesion, the study of Hassona et al cited that 87.6% of MP referred their patients to the pertinent expert, without defining the specialty (Table 3).\cite{21}

Intervention studies: Based on the study by Mowat et al, after a six-month period after intervention, no significant dif-
Fig. 4. Forest plots for identification of OC/OPC precancerous lesions.

Fig. 5. Forest plots for identification of common OC/OPC development sites.
Fig. 6. Forest plots for identification of OC/OPC clinical characteristics.

Fig. 7. Forest plots for identification of OC/OPC clinical aspects.
Fig. 8. Forest plots for MPs’ practices towards OC/OPC.

Fig. 9. Forest plots for US family physicians’ attitudes towards OC/OPC.
Sensitivity analysis

Meta-analyses stratified by continents where the studies were conducted

The sensitivity analysis stratified for different continents was applicable only for the 13 outcomes of this review, as a minimum number of two studies from each continent were required. In particular, compared to European MP, significantly more Asian MP answered correctly that the history of previous oral and maxillofacial malignancy (chi squared = 89 932, p < 0.001), diet (chi squared = 82 941, p < 0.001) and advancing age (chi squared = 24 317, p < 0.001) are risk factors for OC/OPC (Appendix Fig. 1). Compared with Asian MP, fewer European MP answered correctly that early OC lesions usually appear as small, painless red areas (chi squared = 9815, p < 0.05) (Appendix Fig. 1).

Compared with their Asian counterparts, more European MP stated correctly that the tongue is a common intraoral location for OC development (chi squared = 13 076, p < 0.001) as well as they were willing to receive to further education/training on OC/OPC (chi squared = 45 351, p < 0.001) (Appendix Fig. 2).

Compared with European and Asian MP, fewer USA MP answered correctly that erythroplakia (chi squared = 186 451, p < 0.001) and leukoplakia (chi squared = 289471, p < 0.001) are precancerous oral lesions (Appendix Fig. 3). However, in comparison with their Asian counterparts, more USA MP asked their patients about tobacco use (chi squared = 45 351, p < 0.001) and alcohol consumption (chi squared = 210 36, p < 0.001) during history taking (Appendix Fig. 4). Additionally, compared with Asian MP, more European MP stated that they do intraoral examinations on a routine basis (chi squared = 20 397, p < 0.001) (Appendix Fig. 5).

No significant difference was seen among the MP knowledge status in the questions/statements that the tobacco use (chi squared = 3523, p > 0.05) and alcohol consumption (chi squared = 1134, p > 0.05) are risk factors for OC/OPC and squamous cell carcinoma is the most common histological type of OC/OPC (chi squared = 2 3159, p > 0.05) (Appendix Figs. 6–7).

Publication bias

No publication bias was detected in any analyses with LFK index values of Doi plots indicating minor or no asymmetry (Appendix, Figs. 8–10).

Correlating factors

Excluding the study of Canto et al, three studies reported an inverse correlation between the OC/OPC knowledge and the length time from graduation, with more recently-graduated MP (less than 10–15 years) having better OC/OPC knowledge in terms of risk factors and diagnosis.17–19,23
Additionally, based on the study by Applebaum et al, both MP solo medical practice, and referral of fewer than 10 patients with suspicious oral lesions, correlated with worse OC/OPC knowledge score.17 Additionally, a positive correlation was cited between OC/OPC diagnosis score and MP who had attended an OC continuing education programme within the last five years or had encountered patients with OC or oral potentially malignant disorders during their training/practice.22,23

The provision of OC/OPC examination was also associated with better knowledge score,34 higher perceived level of confidence,34 earlier graduation time, and more years in medical practice.28,31 With regard to patients’ OC/OPC consultation, the MP age (over 40 years),31 long-term medical practice,28 and willingness or interest to receive further education31,32 correlated positively with the frequency of asking about smoking status or alcohol during history-taking.

**Barriers**

From MP perspective, among the barriers presented towards OC/OPC education competence 20,25,29,35 were deficiencies in organised training and practical guidelines and information.25 Further hindrances stated by the MP were the lack of self-confidence33,35 and clinical time25,33,35 for the conduct of an intraoral examination.

**Discussion**

From a clinical perspective, this systematic review addressed two fundamental research questions: what are the education competences of MP towards OC/OPC and how these are influenced exposing MP to an OC/OPC educational intervention? To date, we know of no available systematic review that has aimed to identify the available scientific evidence on those topics. Overall, the outcomes of this comprehensive review mirrored MP deficiencies and gaps in OC/OPC knowledge status regarding diagnostic process, overlooked responsibilities, important deviations in OC/OPC knowledge, and the incidence of practices depending on the origin of the study, and barriers towards head and neck cancer screening. The number of existing studies investigating the effectiveness of OC/OPC educational practices in MP competencies are limited, and therefore further research in this field should be conducted.

In terms of MP knowledge status, excluding tobacco use, alcohol consumption, and history of previous oral and maxillofacial malignancy, over half of MP neglected significant OC/OPC risk factors including HPV, advancing age, diet, and ultraviolet radiation. The available epidemiological studies support the statement that the risk of OC development is fivefold to ninefold for smokers compared with non-smokers, rising up to 17 times for extremely heavy smokers who consume 80 or more cigarettes/day.52-47 A twofold to sixfold greater risk for development of a second malignancy in the upper aerodigestive tract has also been observed among treated OC patients who persist in smoking.44,48

Alcohol consumption has been also documented as a major risk factor for cancers of the upper aerodigestive tract.44-47 In particular, in studies controlled for smoking, moderate-to-heavy drinkers present a threefold to ninefold greater risk for OC development.44-47 Additionally, based on the study of Andre et al, extremely heavy drinkers who consume more than 100 grams of alcohol/day, had a 30-fold greater risk of development of OC and OPC.43

With respect to HPV, genotypes 16 and 18 have been considered as independent or partial risk factors for OC/OPC.49 Although the available scientific evidence about the confounding effects of tobacco and alcohol is restricted, the meta-analysis of Ndiaye et al reported that the estimated global HPV16 subtype prevalence accounts to 14.9% and 40.6% in OC and OPC squamous carcinomas, respectively.50 The same study advocates that the estimates for HPV18 subtype prevalence is 5.9% and 0.2% in OC and OPC squamous carcinomas, respectively.50 The International Agency for Research on Cancer (IARC) categorises HPV16 subtype as a risk factor with substantial evidence, indicating its involvement in the pathogenesis of OC and OPC squamous carcinomas. IARC also enlists HPV18 subtype as an agent with restricted evidence supporting its causal association with OC squamous carcinoma.50 In terms of dietary factors, the consumption of fruits and vegetables has been inversely associated with OC/OPC risk.51-54 The study of Lucenteforte et al reported a pooled relative risk for high vegetable consumption of 0.65 based on three cohort studies on upper aerodigestive tract cancer, and 0.52 relying on 18 case-control studies of OC/OPC. For fruit consumption, the corresponding figures were 0.78 and 0.55, respectively.52 The salutary role of vegetables and fruits is attributed to their components including micronutrients, flavonoids, polyphenols, and fibres, which exhibit both supplementary and overlapping mechanisms of action that involve, antioxidant activity, binding, and dilution of carcinogens in the digestive tract.52-56

Finally, ultraviolet radiation exposure is an important risk factor for vermilion carcinomas, considering its implications in the development of actinic cheilitis.57-59

According to our findings, the MP knowledge level about premalignant oral lesions was shown to be low to moderate. Among the most common oral precancerous lesions included are leukoplakia, oral submucous fibrosis (OSMF), oral erythoplaikia, oral lichen planus, and actinic cheilitis.60-64 Malignant or dysplastic transformation of oral leukoplakia ranges between 15.6% and 39.2% among the available studies, while for oral lichen planus the rate of malignant transformation occurs in 0 to 10% for an observation period of 1.5 to 10 years.62-67 Oral erythoplaikia of the homogeneous type should be considered a much more alarming lesion than leukoplakia.63 According to the study by Shafer and Waldron, all the 65 biopsies analysed with homogenous erythoplaikia presented at least some degree of epithelial dysplasia.62 In
particular, 51% were histologically diagnosed as invasive carcinomas, 40% as carcinoma in situ or severe dysplasia, and the remaining 9% showed mild to moderate dysplasia.\textsuperscript{52} Actinic cheilitis is a potentially premalignant lesion of the lip associated mainly with chronic exposure to sun, displaying malignant transformation that ranges between 1.4% and 36% at an interval of 1–30 years.\textsuperscript{59}

In terms of diagnosis, OC/OPC carcinomas remain undetected at early stage due to their asymptomatic character.\textsuperscript{50} In the event of later and more remarkable sized lesions the symptoms may vary between moderate disturbance and severe pain. Among the symptoms included are ear pain, bleeding, mobility of teeth, problems in breathing, difficulty in speech, swelling in the neck or jaw, dysphagia, problems using prostheses, trismus, and aesthetic neurological disturbances.\textsuperscript{68–72} Other rarely observed manifestations involve delayed healing after a dental extraction, a lump with abnormal supplying blood vessels, and weight loss.\textsuperscript{68,69}

With regards to the treatment strategy, a multidisciplinary team is required to ensure a propitious outcome.\textsuperscript{73} Surgical resection is undoubtedly considered the treatment of choice for squamous OC/OPC as it enables accurate pathological staging, and also provides information about the status of margins, tumour spread, and histopathological features, which subsequently indicate the management.\textsuperscript{73} Adjuvant radiotherapy combined with or without chemotherapy is applied to improve the survival of patients with squamous OPC. According to a meta-analysis of 93 randomised clinical trials involving a pooled cohort of more than 17 000 patients, the benefit of intensity-modulated radiotherapy of 70 Gy over a period of 6–7 weeks with concurrent cisplatin improved the survival rate of patients with head-neck cancer.\textsuperscript{74} A cohort study of patients at the Memorial Sloan Kettering Cancer Center in 2015 yielded an overall five-year survival of 63%. Considering the survival rates of historical cohorts, the aforementioned finding advocates a substantial improvement in overall five-year survival over time, which may be attributed to a wider use of microvascular free flaps along with increased surgical ability for large tumours’ ablation and reconstruction.\textsuperscript{53,75–81}

The MP should be familiarised with an OC/OPC screening protocol involving both extraoral and intraoral examination components. In particular, extraoral examination should involve inspection of the head and neck, and bimanual palpation of both lymph nodes and salivary glands as well.\textsuperscript{82–85} Intraoral examination dictates inspection and palpation of lips, buccal mucosa, gingival/alveolar ridge, the lateral borders and ventral/dorsal surfaces of tongue, floor of mouth, hard palate, soft palate, and oropharynx.\textsuperscript{39,79} According to American Cancer Society recommendations, an OC examination should be conducted annually for people over 40 years of age.\textsuperscript{383} Similarly, the US Preventive Service Task Force suggests an OC examination for users of tobacco and alcohol.\textsuperscript{84} In a recently published article, IARC members underlined the necessity for improved health resources and access to them in developing countries.\textsuperscript{2} The authors also emphasised the importance of preventative risk factors, prompt diagnosis involving visual oral screening of high-risk individuals, and established referral criteria that prioritise the biopsy of highly potential malignant lesions.\textsuperscript{2,84}

Based on the findings of this review, the MP indicated both their insufficient training and knowledge deficiency as barriers in terms of patient’s oral health assessment and provision of advice during medical practice. The study by Reed et al cited that 98% of fourth-year South Carolina medical students agreed that an OC examination should be a routine part of a comprehensive oral examination, while only 18% agreed that they were adequately trained to examine patients for OC.\textsuperscript{86} Additionally, a noteworthy finding of the National Health Interview Survey indicated that 53% of current smokers cited said that they had visited a DP at least once in the year preceding the survey, while more than 70% of smokers had seen a physician in the year preceding the survey.\textsuperscript{87} The current study pointed out that most MP displayed a positive disposition towards receiving further oral health training and establishing collaboration with oral health practitioners, as well.

These findings highlighted the need for better OC/OPC training at all levels of Medical Education (undergraduate, postgraduate, specialty training) improving MP diagnostic abilities, promoting prevention and management strategies, and adopting positive attitudes towards oral health assessment. Educational programmes should optimally emphasise assessment of risk factors, meticulous OC/OPC physical examination, definitive diagnosis, behaviour modification counselling, criteria for referral to a specialist for a biopsy, and treatment. The study by Ferry et al reported that approximately 69% of USA medical schools did not require clinical training in smoking cessation techniques.\textsuperscript{88} In the UK, based on the responses of 20 medical curricula directors, up to 40% of medical schools included oral health/OC and OPC history-taking in student assessment, 35% included clinical examination of the mouth, and 55% included clinical examination of the neck.\textsuperscript{59}

Additionally, the retrospective study by Holmes et al showed that detection of an intraoral lesion during non-symptom-driven examinations was associated with a significantly smaller size clinically and lower pathological and clinical stages compared with a lesion detected during a symptom-directed examination.\textsuperscript{90} The same study indicated that 79% of patients referred from dental offices had early stage (stage I or II) disease, whereas only 28% of patients with tumours referred from primary care physicians’ offices were at early stage. All lesions detected by physicians occurred during a symptom-driven examination compared with DP and dental hygienists. The physicians, oral and maxillofacial surgeons, ear/nose/throat specialists, and denturists detected and referred larger oral and oropharyngeal squamous carcinomas, of higher clinical and pathological stage.\textsuperscript{90}

In general, it can easily be concluded that the professional diagnostic delay in OC/OPC is reliant on the clinician’s ability to interpret promptly and accurately the patient’s signs and
symptoms, assessing concurrently the demographic information, the social records and the patient’s past experience.\textsuperscript{91} Because the elimination of diagnostic delay implies earlier diagnosis of malignant or premalignant lesions, the contribution of training, clinical interests and clinician’s index of suspicion combined with a well-founded and broad knowledge of the presentation of the disease are also of paramount importance. Simultaneously, cancer education should focus on cultivating preventive attitudes and effective practices at undergraduate and professional (medical and dental) level.

The establishment of cooperation between clinicians and medical educators is considered essential to optimise OC/OPC teaching. Although there is no substantial evidence about the most effective teaching method with respect to OC/OPC, the involvement of patients, particularly cancer survivors and portfolio-based learning have yielded remarkable learning outcomes.\textsuperscript{92,93} Additionally, the promotion and implementation of interprofessional teaching and assessment between medical and dental students as well as among medical and dental practitioners is generally considered a good prospect.\textsuperscript{94,95} The existing scientific evidence about the impact of educational interventions on MP OC/OPC educational competence is scarce. Further studies involving properly-designed educational interventions, should therefore be conducted worldwide, to investigate the longitudinal effectiveness of OC/OPC educational methods. A noteworthy finding in the study by Mowat et al, was that six months after the attendance of an interprofessional educational intervention, the total OC practice score returned to its baseline percentages. As continuous professional development (CPD) should be an ongoing cyclical process of self-appraisal, the latter finding indicates that further research is required to specify the reasons why such collaborative behaviours were not preserved. At the same time, the development of an efficient cyclical educational programme focused on OC/OPC could result in sustainable learning outcomes.

In the context of e-learning, and based on the study by Varela-Centelles et al, there are numerous reliable web-based and free-access resources on OC screening and diagnostic process, intended for all health-care professionals.\textsuperscript{96} Additionally, CPD resources and activities addressed similarly to all health care providers, including books and on-line courses, are considered supplementary educational tools with the perspective to improve the existing educational gaps.

Although the present review included several comparative studies it was not among the scopes of this systematic review to compare the MP educational competence with the corresponding competence of DP; in particular, DP have received purely formal dental education and training and any contrasts and juxtapositions would be pointless. Finally, potential limitations of this systematic review regarding the applied search strategy could be that only papers in the English language were studied, and the few online databases consulted. The overall quality of the available evidence was downgraded mainly by the lack of validated and reliable tools or instruments designed properly to measure the knowledge status, skills, attitudes, practices and behaviors of MP towards OC/OPC. The generation of a new educational instrument with established psychometric properties, structured to gauge the OC/OPC educational competences of MP worldwide should be considered a forthcoming topic of scientific research.

Conclusions

The outcomes of this comprehensive review mirrored MP deficiencies and gaps in knowledge status regarding prevention and diagnosis of OC/OPC. Additionally, the study highlighted overlooked responsibilities, deviations in the OC/OPC knowledge status and the incidence of practices depending on the study origin, as well as associated barriers towards OC/OPC. A necessity for improved OC/OPC training at all levels of medical education is required to enhance MP competence worldwide.

Conflict of interest

We have no conflicts of interest.

Ethics statement/confirmation of patients’ permission

These were not required.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.bjoms.2019.08.007.

References


