SA Journal of Oncology
ISSN: (Online) 2523-0646, (Print) 2518-8704

Epidemiology of head and neck cancer in a Johannesburg Hospital: A file review

Authors:
Kim Coutts[1]
Nicole Israel[2]
Zareen Cassim[3]
Engela Prinsloo[3]

Affiliations:
[1]Department of Speech Pathology, Faculty of Humanities, University of the Witwatersrand, Johannesburg, South Africa

[2]Department of Psychology, Faculty of Humanities, University of the Witwatersrand, Johannesburg, South Africa

[3]Department of Speech Pathology, Helen Joseph Hospital, Department of Health, Johannesburg, South Africa

Corresponding author:
Kim Coutts,
kim.coutts@wits.ac.za

Dates:
Received: 26 May 2023
Accepted: 02 Nov. 2023
Published: 18 Dec. 2023

How to cite this article:
Coutts K, Israel N, Cassim Z, Prinsloo E. Epidemiology of head and neck cancer in a Johannesburg Hospital: A file review. S. Afr. j. oncol. 2023;7(0), a276.https://doi.org/10.4102/sajo.v7i0.276

Background: There is little to no epidemiological data on the presentation of head and neck cancer (HNC) patients in South Africa. These data are important to ensure that local teaching, research and health services meet the needs of this population.

Aim: To describe the epidemiological data of HNC patients using a record review from a tertiary level hospital in Johannesburg, South Africa.

Setting: This study was piloted in a tertiary public hospital in Gauteng, South Africa.

Methods: Sixty files between 2015 and 2021 were analysed quantitatively to describe the trends of HNC patients presenting to the hospital. This was a pilot study to review if this methodology can be used for future larger scale studies in South Africa.

Results: Missing data were a significant finding as well as a limitation of the study. The most common form of HNC was laryngeal cancer, and African males were the predominant demographic. The most common comorbidities were smoking, hypertension and HIV/AIDS. The majority of patients presented with speech and swallowing difficulties and various complications that required multidisciplinary team management.

Conclusion: All HNC patients need to undergo early screening to assess for speech and swallowing difficulties to prevent further complications.

Contribution: The data derived from this study are novel and specific to the South African population. More studies of this nature are required to increase the availability of epidemiological data for this population, in order to inform evidence-based practices.

Keywords: Head and neck cancer, epidemiology, south africa, public health, file review.

Introduction

There is a paucity of research on the epidemiology of head and neck cancer (HNC) in South Africa. This is somewhat because of poor record keeping from the predominantly public hospital sector and the South African Cancer Registry.[1] This study stemmed from a systematic review by Coutts et al.,[2] which aimed to describe the general epidemiology of HNC patients in Africa using the available literature. The study by Coutts et al. concluded that there are multiple challenges facing HNC patients in Africa and that the paucity of data potentially restricts the contextually appropriate nature of management. It is therefore important to understand the presentation of HNC in South Africa to ensure that treatment guidelines are appropriate for the context.

South Africa is a diverse country with a unique population profile, which can often be characterised using the quadruple burden of disease profile.[3] However, because of the complex nature of HNC, it can be related to multiple lifestyle and cultural habits that are often context specific.[2] Statistics suggest that 68% of the South African population requires the services of the public healthcare sector.[4,5] This places a strain on these often underresourced facilities especially as HNC patients require specialised services only available at tertiary-level hospitals, which are situated in the larger cities. Anecdotally, patients often have to travel lengthy distances to hospitals for follow-ups.

Because of their medical conditions, they are often unable to work, which places them at great financial risk especially considering the assistive devices and rehabilitation required on a long-term basis. The current management guidelines are based on the findings of economically developed countries, which may not be as appropriate for implementation within the diverse South African healthcare setting. If South African healthcare workers are able to better

understand the presentation, risk profile and complications of HNC patients, it is possible that teaching, research and clinical management can become more context-specific allowing for appropriate early detection and prevention strategies. This would then improve patient care and relieve healthcare facilities of the added pressure of managing advanced HNC with the increased risk of complications.

For the purposes of this article, HNC encapsulates the following anatomical areas: nasal and nasopharyngeal cancers, oral and oropharyngeal cancers as well as laryngeal cancers.

Management of head and neck cancer

The management of laryngeal cancer is complex and involves multiple professionals at various stages of management. Surgical management of laryngeal cancer is common[6]; however, it is often only the first step in the recovery process as the removal of the larynx results in significant changes to breathing, smelling, tasting, voicing and swallowing.[1] Thus, the post-surgical management of HNC requires the input of various multidisciplinary team members including a speech-language pathologist (SLP) to assist in voice and swallowing rehabilitation as well as dieticians, nurses and radiation therapists.[7] Patients often require further chemoradiation therapy post-surgery, depending on the stage of the cancer, and these side effects may also require medical or rehabilitative intervention.[8,9] Given the scarcity of resources in Africa, a team approach to the management of such patients is preferential.[2]

Rationale

It is fundamental to understand the epidemiology of HNC in the South African context in order to tailor the identification, prevention, medical and surgical management as well as rehabilitative services to the needs of the local population. This information will also assist in guiding further research in this field in order to ensure that practices are contextually responsive. This study therefore conducted a pilot study using a file review format to describe the epidemiology of HNC patients in a large Gauteng tertiary hospital.

Methodology

The aim of the study was to describe epidemiological trends among patients with HNC accessing services at a Johannesburg tertiary hospital. Data were collected using a retrospective review of patient files. The study was quantitative, non-experimental and descriptive and used a purposive convenience sampling approach.[10] A total of 60 patient files that met the inclusion criteria of a diagnosis of head and/or neck cancer and having had treatment at the hospital between 2015 and 2021 were reviewed. The methodology of this study was piloted so that it could be carried out on a larger scale in future research.

Ethical considerations

Ethical clearance was obtained from the University of the Witwatersrand Human Research Ethics Committee (Medical: M210541) and the research site. Data from each file were coded into an MS Excel© spreadsheet and stored on a password-protected computer. Data will be accessible only to the researchers for a period of 5 years. Identifying information was not coded, and thus, patient anonymity was ensured. Data captured from the files included biographical information such as patients' age, gender, race and comorbidities as well as diagnostic information such as cancer location, type and staging; diagnostic tests utilised and treatments received.

Information regarding patients' feeding, speaking and swallowing was also captured. A pilot study was conducted on five files prior to data collection to validate the data collection process. Descriptive statistical analysis of the data was carried out using IBM SPSS v.28©.

Results

Patient demographics

Laryngeal cancer was diagnosed in 33 (55.0%) patients from the 60 patient samples, while 4 (6.7%) presented with nasal cancer and 23 (38.3%) with oropharyngeal cancer (for a detailed breakdown of the type of cancer, please refer to Table 1). Squamous cell carcinoma was the most prevalent type of laryngeal cancer (n = 30 [90.9%]) and oropharyngeal cancer (n = 7 [30.4%]) while all four patients diagnosed with a form of nasal cancer had a unique type of cancer. Table 1 presents data on stage, nodes and metastases in cases where this was available. It was notable that a large portion of those patients with staging information (n = 26 [89.7%]) were Stage 3 or Stage 4, and that only two patients (10.0%) of those with information available had cancer that had metastasised. There were significant data missing on nodal status and more information on this would be beneficial in future studies.

Table 2 presents the demographic characteristics of the sample. The average age of patients in the sample was 61.9 years with a standard deviation of 10.4 (range: 33–82 years). The majority of the sample identified as male (n = 50 [83.3%]); this pattern was especially notable for those with laryngeal cancer, where 31 patients (93.9%) identified as male. Half of the sample (n = 30 [50.0%]) identified as black, 22 (36.7%) as white, 4 as mixed race (6.7%) and 4 as Indian (6.7%) people. Smoking was the only comorbid condition that was significantly more prevalent in the sample than anticipated ($\chi_1 = 4.9$, $p < 0.05$), with just under two-thirds of the sample (n = 38 [63.3%]) indicating that they smoked. This group did not include any of the patients with nasal cancer. The other most frequent comorbid conditions reported were hypertension (n = 12 [20.0%]); HIV (n = 6 [10.0%]); RVD (n = 6 [10.0%]); COPD (n = 5 [8.3%]) and TB or previous TB (n = 5 [8.3%]).

TABLE 1: Cancer location, type and staging (N = 60).

Symptoms	Laryngeal (n = 33)			Nasal (n = 4)			Oropharyngeal (n = 23)		
	Freq.	%	%	Freq.	%	%	Freq.	%	%
Stage									
Stage 1	1	3.0	1.7	-	-	-	-	-	-
Stage 2	-	-	-	1	25.0	1.7	1	4.3	1.7
Stage 3	8	24.2	13.3	-	-	-	5	21.7	8.3
Stage 4	10	30.3	16.7	-	-	-	3	13.0	5.0
Missing	14	42.4	23.3	3	75.0	5.0	14	60.9	23.3
Nodes									
No	12	36.4	20.0	-	-	-	3	13.0	5.0
Yes	5	15.2	8.3	1	25.0	1.7	6	26.1	10.0
Missing	16	48.5	26.7	3	75.0	5.0	14	60.9	23.3
Metastases									
No	13	39.4	21.7	-	-	-	5	21.7	8.3
Yes	1	3.0	1.7	-	-	-	1	4.3	1.7
Missing/mx	19	57.6	31.7	4	100.0	6.7	17	73.9	28.3
Type									
Glottic SCC	1	3.0	1.7	-	-	-	-	-	-
Laryngeal CA	1	3.0	1.7	-	-	-	-	-	-
Laryngeal SCC	30	90.9	50.0	-	-	-	-	-	-
Pharynx SCC	1	3.0	1.7	-	-	-	-	-	-
Ear SCC	-	-	-	1	25.0	1.7	-	-	-
Nasal SCC	-	-	-	1	25.0	1.7	-	-	-
Nasopharyngeal CA	-	-	-	1	25.0	1.7	-	-	-
Nasopharyngeal lymphoma	-	-	-	1	25.0	1.7	-	-	-
Base of tongue SCC	-	-	-	-	-	-	3	13.0	5.0
Base of tongue and tonsil SCC	-	-	-	-	-	-	1	4.3	1.7
Floor and tongue SCC	-	-	-	-	-	-	3	13.0	5.0
Hard palate SCC	-	-	-	-	-	-	1	4.3	1.7
Mandibular alveolar SCC	-	-	-	-	-	-	1	4.3	1.7
Oropharyngeal Kaposi sarcoma	-	-	-	-	-	-	2	8.7	3.3
Oropharyngeal SCC	-	-	-	-	-	-	3	13.0	5.0
Soft palate SCC	-	-	-	-	-	-	1	4.3	1.7
Submandibular SCC	-	-	-	-	-	-	1	4.3	1.7
Tongue SCC	-	-	-	-	-	-	7	30.4	11.7

CA, cancer; SCC, squamous cell carcinoma.

TABLE 2: Sample demographics (N = 60).

Symptoms	Laryngeal (n = 33)			Nasal (n = 4)			Oropharyngeal (n = 23)		
	Freq.	%	%	Freq.	%	%	Freq.	%	%
Age (years)									
30–39	-	-	-	1	25.0	1.7	2	8.7	3.3
40–49	2	6.1	3.3	-	-	-	1	4.3	1.7
50–59	11	33.3	18.3	1	25.0	1.7	6	26.1	10.0
60–69	13	39.4	21.7	-	-	-	9	39.1	15.0
70–79	6	18.2	10.0	1	25.0	1.7	5	21.7	8.3
80–89	-	-	-	1	25.0	1.7	-	-	-
Missing	1	3.0	1.7	-	-	-	-	-	-
Gender									
Female	2	6.1	3.3	1	25.0	1.7	7	30.4	11.7
Male	31	93.9	51.7	3	75.0	5.0	16	69.6	26.7
Race									
Black	15	45.5	25.0	2	50.0	3.3	13	56.5	21.7
Mixed race	2	6.1	3.3	-	-	-	2	8.7	3.3
Indian	2	6.1	3.3	1	25.0	1.7	-	-	-
White	14	42.4	23.3	1	25.0	1.7	7	30.4	11.7
Missing	-	-	-	-	-	-	1	4.3	1.7
CMC									
Alcohol	2	6.1	3.3	-	-	-	2	8.7	3.3
Asthma	2	6.1	3.3	-	-	-	1	4.3	1.7
COPD	4	12.1	6.7	-	-	-	1	4.3	1.7
CVA	-	-	-	-	-	-	1	4.3	1.7
DM/diabetes	3	9.1	5.0	-	-	-	1	4.3	1.7
Hearing loss	-	-	-	1	25.0	1.7	1	4.3	1.7
HIV	2	6.1	3.3	-	-	-	4	17.4	6.7
HPT	8	24.2	13.3	2	50.0	3.3	2	8.7	3.3
RVD	3	9.1	5.0	1	25.0	1.7	2	8.7	3.3
Renal dysfunction	-	-	-	2	50.0	3.3	-	-	-
Smoking	22	66.7	36.7	-	-	-	16	69.6	26.7
TB/previous TB	2	6.1	3.3	1	25.0	1.7	2	8.7	3.3
UTI	-	-	-	1	25.0	1.7	-	-	-
Missing	-	-	-	1	25.0	1.7	-	-	-

COPD, chronic obstructive pulmonary disease; CMC, comorbid condition; CVA, cerebrovascular accident; DM, diabetes millitus; HIV, human immunodeficiency viruses; HPT, hypertension; RVD, retroviral disease; TB, tuberculosis; UTI, urinary tract infection.

Diagnostic tests and treatment protocols

The most frequent diagnostic methods used were CAT (CT) scan (n = 40 [66.7%]), biopsy (n = 34 [56.7%]), chest X-ray (n = 23 [38.3%]), direct laryngoscopy (n = 19 [31.7%]), blood tests (n = 17 [28.3%]), panendoscopy (n = 7 [11.7%]) and echo cardiogram (ECG) (n = 7 [11.7%]). Among patients for whom information was available, 45 (86.5%) underwent surgery; 10 (66.7%) received chemotherapy and 24 (80.0%) received radiation therapy.

The most frequent surgical procedures for those with laryngeal cancer included the fitting of a tracheostomy tube (n = 15 [45.5%]), a total laryngectomy (n = 13 [39.4%]) and percutaneous endoscopic gastrostomy (n = 3 [9.1%]). For those with oropharyngeal cancer, the most frequent procedures were fitting a tracheostomy tube (n = 6 [26.1%]), percutaneous endoscopic gastrostomy (n = 5 [21.7%]), resection (n = 2 [8.7%]) and neck dissection (n = 2 [8.7%]). Each patient with nasal cancer underwent surgery, which included the fitting of a tracheostomy tube (n = 1 [25.0%]), percutaneous endoscopic gastrostomy insertion (n = 1 [25.0%]), resection (n = 1 [25.0%]) and maxillectomy (n = 1 [25.0%]).

It is noted that the majority of the patients presented in the later stages and underwent surgical procedures such as PEGs and tracheostomy tube insertions, but the data did not indicate if treatment was curative or palliative in nature. This is something that future studies can include in their analysis.

Speech factors and complications

For those with laryngeal cancer, there were six patients (18.2%) on whom a speech valve was implanted successfully and another four (12.1%) who were scheduled to have one placed. There were 32 patients recorded with complications, 5 of those were related to feeding difficulties and 7 were related to speech difficulties.

Dietary and eating factors

There were 18 (30.0%) patients in the sample who were placed on oral diets, 7 (11.7%) who received full ward diet, 4 (6.7%) who received a soft diet, 4 (6.7%) who received mixed fluids and

3 (5.0%) who received puree. There was 1 (1.7%) patient in the sample who received an open gastrostomy, 14 (23.3%) who had a percutaneous endoscopic gastrostomy and 2 (3.74%) were on short-term enteral feeding options, such as a nasogastric tube.

Speech and swallowing symptoms experienced

In cases where information was available, 19 (82.6%) patients with laryngeal cancer experienced speech symptoms and 14 (63.6%) experienced dysphagia symptoms; 6 (75.0%) patients with oropharyngeal cancer experienced speech symptoms and 16 (88.9%) experienced dysphagia symptoms and 2 (66.7%) patients with nasal cancer experienced speech symptoms and 3 (75.0%) experienced dysphagia symptoms. The most common speech symptoms experienced were a hoarse voice (n = 15 [25.0%]), aphonia (n = 3 [5.0%]), hypernasality (n = 3 [5.0%]) and difficulty articulating (n = 3 [5.0%]). The most common dysphagia symptoms were odynophagia (n = 15 [25.0%]), aspiration (n = 4 [6.7%]), coughing/penetration (n = 2 [3.3%]) and nasal regurgitation (n = 2 [3.3%]). For a full breakdown of speech and dysphagia symptoms, please refer to Table 3.

In general, 50% of data in files on the different variables explored by this study were missing or incomplete. Not one file had all of the variables available for recording. This is not only a significant limitation but also an important finding when reflecting on patient record keeping in the South African sector.

Discussion

Patient demographics

Laryngeal cancer appeared to be the most common HNC diagnosis. The study by Coutts et al.[2] showed that oral cancers appeared to be more prevalent in Africa, so this is an interesting finding. The most common type of cancer was squamous cell carcinoma and patients in the sample often had a diagnosis of stage 3 or stage 4 cancer, thus illustrating that patients appeared to present to healthcare professionals later on in the disease process. This is in keeping with literature and the findings from the study by Coutts et al.[2] It is no surprise that the most frequent comorbidity was smoking, as this was also confirmed in the systematic review by Coutts et al.[2] However, this sample also showed that HIV/AIDS was a common comorbidity, whereas HPV was more common in African literature.[2] The researchers do not believe that hypertension is directly linked to HNC, but merely common in these findings because of the average age group of the sample.

TABLE 3: Speech and dysphagia symptoms (N = 60).

Symptoms	Laryngeal (n = 33)			Nasal (n = 4)			Oropharyngeal (n = 23)		
	Freq.	%	%	Freq.	%	%	Freq.	%	%
Speech symptoms									
Hoarse voice	13	39.4	21.7	1	25.0	1.7	1	4.3	1.7
No voice	1	3.0	1.7	1	25.0	1.7	-	-	-
Aphonia	2	6.1	3.3	-	-	-	1	4.3	1.7
Hypernasality	-	-	-	1	25.0	1.7	2	8.7	3.3
Difficulty voicing/ speaking	3	9.1	5.0	-	-	-	-	-	-
Slurred speech	-	-	-	-	-	-	1	4.3	1.7
Pain when speaking	-	-	-	-	-	-	1	4.3	1.7
Reduced phonation	-	-	-	-	-	-	1	4.3	1.7
Obturator plate in situ	-	-	-	1	25.0	1.7	-	-	-
Dysphagia symptoms									
Odynophagia	5	15.2	8.3	1	25.0	1.7	9	39.1	15.0
Aspiration	3	9.1	5.0	-	-	-	1	4.3	1.7
Coughing	2	6.1	3.3	-	-	-	-	-	-
Nasal regurgitation	-	-	-	-	-	-	2	8.7	3.3
Stridor	1	3.0	1.7	-	-	-	-	-	-
Vomiting	-	-	-	1	25.0	1.7	-	-	-
Xerostomia	-	-	-	1	25.0	1.7	-	-	-
Reduced lingual movement	-	-	-	-	-	-	1	4.3	1.7

In line with the literature, the most common treatment was surgery with a combination of chemotherapy and radiation[2]; however, this study did not delve into the waiting times needed for these procedures. This is potentially an important factor to be considered in future studies particularly within the South African context. In terms of missing data, it is interesting to note that the least amount of missing data was related to patient demographics and comorbidities and instead, missing data were largely seen in the description of the medical management of patients.

Complications and rehabilitation factors

These data are relatively novel for the field and are fundamental for the development of screening and assessment tools for the South African context specifically. In a setting where access to multiple healthcare team workers is limited, tools that can be used by different professionals for screening could facilitate the earlier identification and referral processes. It is evident that patients with HNC require a multidisciplinary team approach,[7] with a specific focus on a need for early rehabilitation to prevent complications. This team needs to include SLPs and dietitians as rehabilitation specialists, especially as HNC has an effect on swallowing. Internationally, practice patterns of rehabilitation services vary greatly[7] and therefore, this area requires further investigation in order to develop standardised protocols for universal practice.

Speech and swallowing factors

Because of the nature of HNC, it is expected that speech and swallowing would be impacted; however, this study further details the symptoms seen in this population, a novelty for studies in the South African context. In the study by Coutts et al.,[2] dysphagia was one of 10 most common signs of HNC. In this study, 25% of the sample had a hoarse vocal quality, a risk factor for aspiration, and such patients required a dysphagia assessment with considerations for the presence of adequate airway closure.[11]

Odynophagia was present in 25% of the sample and should be included in future screening tools for quality-of-life purposes.

Merely 6% of the sample presented with aspiration but if not timeously managed, the risk for aspiration pneumonia, increased length of hospital stay and further complications are high. Thus, it is critical to screen for and manage dysphagia and aspiration as early on as possible. It must be noted that 26% of the files had missing data related to speech and swallowing symptomology and 15% of the sample did not record data on feeding methods. This is of concern especially as patients with HNC are at high risk for dysphagia and a decreased quality of life.

Conclusion

This pilot study yielded significant findings that were novel for the field and may be valuable in assisting with the advancement of clinical screening and management tools as well as with the development of methodologies for larger studies. Missing data are a significant concern in the public healthcare sector and require attention for accurate record keeping as well as legal and research purposes and are noted as a significant limitation, not only of this study but also potential studies in similar contexts going forward. The authors also acknowledge that because only 60 patient files could be obtained at the time of the study, the data presented here are only specific to this site and more information is needed in order to develop significant generalisable results. This methodology allows for future studies to be done that can answer these questions. It is imperative that HNC patients are referred for the assessment of speech and swallowing difficulties that may result in aspiration, hinder quality of life and negatively impact overall management.

Acknowledgements

Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

K.C. assisted with conceptualisation, data analysis and write up. N.I. assisted with data analysis. Z.C. and E.P. assisted with data collection.

Funding information

This was self-funded.

Data availability

Data supporting the findings of this study are available from the corresponding author, K.M., on request.

Disclaimer

The views and opinions expressed in this article are those of the authors and are the product of professional research. It does not necessarily reflect the official policy or position of any affiliated institution, funder, agency, or that of the publisher. The authors are responsible for this article's results, findings, and content.

References

1. Herbst M. Cancer Association of South Africa (CANSA) fact sheet on laryngeal cancer [homepage on the Internet]. 2021 [cited 2021 Apr 15]. Available from: https://cansa.org.za/files/2021/01/Fact-Sheet-on-Cancer-of-the-Larynx-NCR-2017-web-January-2021.pdf
2. Coutts KA, Seedat J, Vlok E, Coutts K. The management of head and neck cancer in Africa. What lessons can be learned from African literature? S Afr J Oncol. 2022;6:a204. https://doi.org/10.4102/sajo.v6i0.204
3. Pillay-Van Wyk V, Msemburi W, Laubscher R, et al. Mortality trends and differentials in South Africa from 1997 to 2012: Second National Burden of Disease Study. Lancet Glob Health. 2016;4(9):e642–e653. https://doi.org/10.1016/s2214-109x(16)30113-9
4. Coovadia H, Jewkes R, Barron P, Sanders D, Mcintyre D. The health and health system of South Africa: Historical roots of current public health challenges. Lancet. 2009;374(9692):817–834. https://doi.org/10.1016/s0140-6736(09)60951-x
5. STATSSA. No title [homepage on the Internet]. 2018 [cited 2019 Jun 04]. Available from: http://www.statssa.gov.za/?s=population&sitem=publications
6. Babin E, Blanchard D, Hitier M. Management of total laryngectomy patients over time: From the consultation announcing the diagnosis to long term follow-up. Eur Arch Otorhinolaryngol. 2011;268(10):1407–1419. https://doi.org/10.1007/s00405-011-1661-4
7. Logan AM, Landera MA. Clinical practices in head and neck cancer: A speech-language pathologist practice pattern survey. 2021;130(11):1254–1262. https://doi.org/101177/00034894211001065
8. Patterson JM, Rapley T, Carding PN, Wilson JA, McColl E. Head and neck cancer and dysphagia; caring for carers. Psychooncology. 2013;22(8):1815–1820. https://doi.org/10.1002/pon.3226
9. Cancer Research UK. TNM stages | laryngeal cancer [homepage on the Internet]. 2018 [cited 2021 Apr 15]. Available from: https://www.cancerresearchuk.org/about-cancer/laryngeal-cancer/stages-types-grades/stages/TNM-staging
10. Palinkas LA, Horwitz SM, Green CA, Wisdom JP, Duan N, Hoagwood K. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. Adm Policy Ment Heal Ment Heal Serv Res. 2015;42(5):533–544. https://doi.org/10.1007/s10488-013-0528-y
11. Matsuo K, Palmer JB. Coordination of mastication, swallowing and breathing. Jpn Dent Sci Rev. 2009;45(1):31–40. https://doi.org/10.1016/j.jdsr.2009.03.004