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A commentary on 'The use of multilayer perceptron and radial basis function: an artificial intelligence model to predict progression of oral cancer': correspondence

Saravanan Muthupandian, PhD[a], Jesu Arockiaraj, PhD[b,*], Melaku A. Belete, MSc[c,*]

Dear Editor,

Oral cancer is the seventh most common kind of cancer in the globe, with a high prevalence in Eastern Europe[1]. Carcinogenesis has been extensively researched during the past few decades, but its prognosis has not improved[2]. Squamous cell carcinoma accounts for more than 80% of oral malignancies and is caused by oral potentially malignant conditions[3]. Therefore, the therapy for this condition might be much enhanced by their early detection, proper screening, and estimate of the cancerization risk. Large amounts of information are necessary for any choice. Following exposure to carcinogens, a complex series of genetic, epigenetic, and metabolic changes take place during carcinogenesis, and many different variables are involved[4]. Different patients may experience the condition in varying degrees of intensity. Uncertainties are present in certain data, the majority of which are given by patients. A doctor would find it challenging to analyze such a large amount of data; thus, it should be automated and used wisely. Conventional statistical techniques were used, although they are time-consuming and not appropriate in every situation.

Adeoye and Su[5] elaborated on the use of artificial intelligence (AI), which has the potential to integrate various factors influencing malignant transformation for robust, precise, and personalized cancer risk stratification of oral potentially malignant disorder (OPMD) patients. Therefore, in order to support the clinical application of AI-based platforms for cancer risk stratification of OPMDs in surgical practice, this article presents a clinical implementation pathway, reviews current AI models and tools, and discusses necessary improvements.

Jayaram *et al.*[6] showed AI-based prediction is a compelling alternative to the current prediction technologies for oral cancer. This approach is based on machine learning, a technique that can recognize patterns and generalize them in a way that is similar to how humans learn. Machine learning algorithms developed and applied by researchers have shown to be quite useful. Many studies advocate the use of AI in oral medicine, with a focus on oral cancer in particular. Only a small number of them forecast or diagnose oral cancer, while the bulk of them identify, categorize, detect, or discriminate tumors[7,8].

The term 'fuzzy' set, which was first used in 1965, refers to a superset of traditional logic that is utilized in mathematics and systems theory. A fuzzy set provides an entirely different approach to the traditional understanding of the set and the set element, in which existence is either an element of the set or it is not[9]. To be more specific, there is a wide variety of transient, continuous circumstances that are distinguished by values that indicate the degrees of membership between the elements' membership and non-membership[9]. In its most basic form, fuzzy logic stretches the true/false dichotomy to encompass a variety of degrees of truth responses in between. Fuzzy logic, which introduces partial truths, is more applicable in the medical field since diagnosis necessitates complicated data with several levels of ambiguity and imprecision[10].

Machine learning has been used as a tool in the management of cancer in various studies[11]. Fuzzy sets have already been utilized to predict oral cancer susceptibility[11], nasopharyngeal carcinoma prognosis[12], esophageal cancer outcome[13], and cervical lymph node metastases in carcinoma of the tongue[14]. Cancer prognosis or prediction refers to the evaluation of the susceptibility to developing the illness and the prediction of its recurrence and survival and is distinct from cancer detection and diagnosis[15]. Scrobota *et al.*[16] is the first study to suggest the use of fuzzy logic in assessing the susceptibility to and risk of developing oral cancer in cases of potentially malignant conditions in which oxidative stress measurements are used as inputs. Utilizing a multi-criteria decision support system based on the values of proton donors and serum malondialdehyde, they calculated the cancerization risk of oral, possibly malignant illnesses. Depending on the input linguistic/numerical value, the risk was calculated as a specific numerical value on a scale from 1 to 10.

[a]AMR and Nanomedicine Laboratory, Department of Pharmacology, Saveetha Dental College & Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Chennai, [b]Toxicology and Pharmacology Laboratory, Department of Biotechnology, Faculty of Science and Humanities, SRM Institute of Science and Technology, Chengalpattu District, Kattankulathur, Tamil Nadu, India and [c]Department of Medical Laboratory Science, College of Medicine and Health Sciences, Wollo University, Dessie, Ethiopia

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*Corresponding authors. Address: Department of Medical Laboratory Science, College of Medicine and Health Sciences, Wollo University, P.O. Box: 1145, Dessie, Ethiopia. E-mail: melakuashagrie@gmail.com (M.A. Belete), and Toxicology and Pharmacology Laboratory, Department of Biotechnology, Faculty of Science and Humanities, SRM Institute of Science and Technology, Chengalpattu District, Kattankulathur, Tamil Nadu, 603 203, India. E-mail: jesuaroa@srmist.edu.in (J. Arockiaraj).

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Due to the diagnosis being subjective, there is limited clinical ability to predict the cancerization of oral potentially malignant disorders. Not all cases of potentially malignant disorders or even dysplasia necessarily evolve into cancer; some even have the potential to regress; carcinoma can also occur in lesions without any prior dysplasia. Although specific indicators such as oncogenes, mutations in tumor suppressor genes, cell cycle proteins, or DNA transcription factors were taken into account, it has been challenging to determine which oral potentially malignant condition would progress to cancer[16,17].

By incorporating a multi-criteria decision support system using fuzzy logic into a more intricate computerized decision support system, OPMD screening might be significantly aided, and future medical decisions in relation to possibly malignant illnesses of the oral cavity could be made.

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References

[1] Warnakulasuriya S. Global epidemiology of oral and oropharyngeal cancer. Oral Oncol 2009;45:309–16.
[2] López-Lázaro M. A new view of carcinogenesis and an alternative approach to cancer therapy. Mol Med 2010;16:144–53.
[3] Mortazavi H, Baharvand M, Mehdipour M. Oral potentially malignant disorders: an overview of more than 20 entities. J Dent Res Dent Clin Dent Prospects 2014;8:6–14.
[4] Lippman SM, Hong WK. Molecular markers of the risk of oral cancer. N Engl J Med 2001;344:1323–6.
[5] Adeoye J, Su Y-X. Leveraging artificial intelligence for perioperative cancer risk assessment of oral potentially malignant disorders. Int J Surg 2023. [Epub ahead of print]. doi:10.1097/JS9.0000000000000979
[6] Jayaram N, Muralidharan M, Muthupandian S. The use of multilayer perceptron and radial basis function: an artificial intelligence model to predict progression of oral cancer. Int J Surg 2023;109:57.
[7] Dhali A, Kipkorir V, Srichawla BS, *et al*. Artificial intelligence assisted endoscopic ultrasound for detection of pancreatic space occupying lesion: a systematic review and meta-analysis. Int J Surg 2023;109:4298–308.
[8] Moglia A, Georgiou K, Georgiou E, *et al*. A systematic review on artificial intelligence in robot-assisted surgery. Int J Surg 2021;95:106151.
[9] Belohlavek R. Impact of fuzzy logic: a bibliometric view. Int J Gen Syst 2022;51:664–74.
[10] Abbod MF, von Keyserlingk DG, Linkens DA, *et al*. Survey of utilisation of fuzzy technology in Medicine and Healthcare. Fuzzy Sets Syst 2001; 120:331–49.
[11] Cruz JA, Wishart DS. Applications of machine learning in cancer prediction and prognosis. Cancer Inform 2007;2:59–77.
[12] Kumdee O, Bhongmakapat T, Ritthipravat P. Prediction of nasopharyngeal carcinoma recurrence by neuro-fuzzy techniques. Fuzzy Sets Syst 2012;203:95–111.
[13] Hamed RI. Esophageal cancer prediction based on qualitative features using adaptive fuzzy reasoning method. J King Saud Univ - Comput Inf Sci 2015;27:129–39.
[14] Nagata T, Schmelzeisen R, Mattern D, *et al*. Application of fuzzy inference to European patients to predict cervical lymph node metastasis in carcinoma of the tongue. Int J Oral Maxillofac Surg 2005;34:138–42.
[15] Huang S, Yang J, Fong S, *et al*. Artificial intelligence in cancer diagnosis and prognosis: opportunities and challenges. Cancer Lett 2020;471: 61–71.
[16] Scrobotă I, Băciuț G, Filip AG, *et al*. Application of fuzzy logic in oral cancer risk assessment. Iran J Public Health 2017;46:612–9.
[17] Scully C. Challenges in predicting which oral mucosal potentially malignant disease will progress to neoplasia. Oral Dis 2014;20:1–5.