

A NOVEL DEEP LEARNING ALGORITHM TO DETECT COUGH AND THROAT CLEARING EVENTS USING COMPUTER AIDED AUSCULTATION

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ABSTRACT

Refractory chronic cough (RCC) significantly impacts quality of life which necessitates the need for better cough severity assessment and laryngeal injurious behavior quantification. Lack of a standardized method for evaluation has paved the way for Artificial intelligence as a potential tool for effective detection of cough and ongoing laryngeal injurious behavior (e.g., throat clearing). We aim to develop and test a deep learning model for detection and isolation of these events from acoustic recordings of patients with chronic cough presenting to the Mayo Chronic Cough Clinic in Rochester, Minnesota, USA. Post IRB (Institutional Review Board) approval, recordings with a total duration of 158 hours were obtained from participants and manually reviewed. 2113 cough events and 568 throat clearing events were identified and matched to 2681 non-cough events. A deep learning model was developed after augmenting the data to help in event recognition which had an accuracy of 0.804. We present our initial data with reasonable accuracy with a novel artificial intelligence-based algorithm that detects both cough and throat clearing events in patients with RCC. Our goal is to further refine and validate this algorithm with the aim of developing a composite score of laryngeal injury by incorporating cough frequency, amplitude as well as throat clearing events in patients with RCC using an automated AI driven process.

Keywords: cough detection, throat clearings, audio processing, convolutional neural networks, mel-spectrograms

INTRODUCTION

Cough, being one of the most common presenting symptoms in out-patient clinics has been extensively studied but lacks a distinctive definition for chronic cough owing to the overlap in definitive clinical criteria between acute and chronic cough. Long-lasting cough, potentially lasting several decades despite medical intervention [2,3,4] causing immense discomfort to patients has been defined as refractory chronic cough (RCC). The various possible pulmonary and extrapulmonary causes for chronic cough make management difficult necessitating the need for innovative technologies in diagnosing chronic cough. [1] The prevalence of chronic cough is about 10% in general population, higher in Europe, America, and Australia (10-20%) than in Asia (<5%) [5]. Chronic cough is presumed to be caused by hypersensitivity triggered by low levels of thermal, mechanical, and chemical exposure that follows both peripheral and central neural pathways.

Various environmental and patient factors like air pollution, allergens, age, sex, and hormonal factors can influence the presentation and epidemiology of cough [6,7]. The higher prevalence in women