

## Review Article

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# A comprehensive review of otorhinolaryngological global health concerns

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## Abstract

**Background.** ENT disease prevalence, risk factors and treatment vary between developed and developing countries. Health provision, particularly disease prevention strategies and surgery, in developing countries is poor, manifesting as a high frequency of common and preventable diseases. Healthcare systems in developing countries are unsustainable, and the technological advances that provide ENT surgery with novel diagnostic and treatment opportunities are inaccessible.

**Conclusion.** A multifaceted approach is essential to improve the care of patients with ENT diseases in developing countries. Public health efforts must focus on educating the local community, reducing high-risk behaviours and decreasing the frequency of preventable diseases. Governments must be pressured to prioritise the funding of long-term, sustainable efforts with effective disease prevention strategies. Providing local healthcare professionals with high-quality ENT training so that self-sustaining and low-cost care can be delivered, mainly in a primary care setting, is key.

## Introduction

Global health defines the conduction of transnational research to identify variables that influence health, and the use of information gathered to inform evidence-based decisions that aim to improve health across the world.<sup>1</sup>

In 2007, the World Health Organization (WHO) outlined the main threats to global human health in the twenty-first century.<sup>2</sup> These include a rise in epidemic-prone diseases, foodborne diseases, accidental or deliberate outbreaks of infectious disease, toxic chemicals and radio-nuclear materials, and, finally, environmental disasters that influence health through multiple avenues.<sup>2</sup>

An acute threat to global health is climate change.<sup>3,4</sup> Research demonstrates its direct and indirect influence on health. The greatest effect on health will arise from limited access to safe food and water, and dirtier air. Climate change is estimated to contribute to an additional 12.6 million deaths each year.<sup>5</sup>

## ENT and global health

ENT surgery is the surgical specialty concerned with the diagnosis, evaluation and management of head, neck, and ENT diseases.<sup>6</sup> ENT encompasses a vast disease spectrum, much of which is treatable through manoeuvres and medical management, but, equally, surgical intervention is often indicated.

ENT disease prevalence, risk factors and treatment vary between developed and developing countries. Health provision, particularly surgery, in developing countries is poor, and their unstable healthcare systems create barriers that limit the delivery of high-quality care.<sup>7</sup> Technological advances provide ENT surgery with novel diagnostic and treatment opportunities; however, new technology is inaccessible to developing countries, and this contributes to the differences in ENT practice between the developed and developing world.<sup>2,8</sup>

The American Academy of Otolaryngology has outlined the main ENT diseases requiring intervention in low- and middle-income countries. These include thyroid and parathyroid diseases, hearing loss, chronic ear disease, tracheostomy care, and paediatric airway pathologies.<sup>8</sup>

## Hearing loss

In 2012, it was estimated that 5.3 per cent of the world's population were living with disabling hearing loss, defined as a hearing impairment greater than 40 dB when aged 15 years or older, or greater than 30 dB when younger than 15 years.<sup>9</sup> The burden of hearing loss predominates in low- and middle-income countries, particularly sub-Saharan Africa, South Asia and the Asian Pacific.<sup>9–11</sup> The prevalence of hearing loss decreases exponentially as gross national income increases, both for adults and children.<sup>12</sup> Forty-eight per

cent of adults aged over 65 years in South Asia have disabling hearing loss, compared with 18 per cent of those from high-income countries.<sup>12,13</sup>

### Why does hearing loss matter?

Whether from a developed or underdeveloped country, chronic hearing loss in children impairs speech and language development.<sup>14</sup> Disability and handicap results, for example through poor educational and vocational attainment. Unemployment rates are higher in deaf adults, and those that do achieve employment usually receive a lower grade than the general population.<sup>14</sup> Children whose hearing is impaired are more prone to experiencing emotional, sexual and physical abuse, including murder.<sup>14,15</sup>

The WHO estimates that unaddressed hearing loss has a global cost of 750 billion international dollars.<sup>12</sup> Many causes of disabling hearing loss are preventable and, owing to its negative consequences, prevention is paramount.

### Hearing loss in developing countries

The prevalence of childhood disabling hearing loss is higher in developing countries.<sup>13</sup> Of children aged under 15 years of age, 2.4 per cent have disabling hearing loss in South Asia, a low-income region, compared with 0.5 per cent in high-income countries.<sup>13</sup> Eighty per cent of the world's deaf population receive no education. This is particularly skewed towards low- and middle-income countries, where almost no deaf people receive an education. This has devastating consequences for deaf children's futures.<sup>16</sup>

### Hearing loss in children and adolescents

Sixty per cent of disabling hearing loss in children aged under 15 years is preventable. There is a disproportionately high burden in low- and middle-income countries, where 75 per cent of cases are preventable, compared with 49 per cent in high-income countries.<sup>11,12</sup>

Infections are the main preventable cause.<sup>17–19</sup> They occur antenatally (rubella and syphilis) or during infancy (mumps, measles and rubella). Persistent middle-ear infections cause chronic suppurative otitis media (CSOM), a condition affecting 330 million people worldwide. It is more common in low- and middle-income countries, accounting for roughly 25 per cent of the ENT workload, and is associated with higher complication rates.<sup>12,17,20,21</sup>

Complications from childbirth may cause sensorineural hearing loss. This is usually secondary to cerebral damage, which may result from birth asphyxia and hyperbilirubinaemia. These complications more commonly affect premature neonates.<sup>12</sup>

Ototoxicity is the third main cause of hearing loss. It most commonly arises from medication use in babies or pregnant mothers.<sup>12</sup>

### Hearing loss in adults

The difference in frequency of disabling hearing loss cases between low- or middle-income countries and high-income countries is greatest in those aged under 15 years, but adult populations differ too.

Adult disabling hearing loss is usually due to disease originating from childhood, degenerative changes and noise-induced

disabling hearing loss. Many low- and middle-income countries are experiencing rapid urbanisation, and so residents are increasingly exposed to unregulated amounts of noise pollution,<sup>22</sup> which contributes to the high prevalence of noise-induced disabling hearing loss.<sup>14</sup>

### Minimising preventable hearing loss

As many disabling hearing loss cases in low- and middle-income countries are preventable, we can intervene in numerous ways to reduce its incidence. Self- and herd-immunity can be induced through providing childhood immunisations, particularly against measles, mumps, rubella and bacterial meningitis.<sup>12,14,19</sup> Contraceptive access in low- and middle-income countries is poor. Therefore, immunising women of reproductive age against rubella, screening pregnant females for syphilis, and improving antenatal care all help to reduce neonatal disabling hearing loss.<sup>12,14,19</sup>

Preventing the vertical and horizontal transmission of human immunodeficiency virus would help to reduce complications that occur secondary to CSOM (odds ratio = 4.3, 95 per cent confidence interval (CI) = 1.17–15.6;  $p = 0.028$ ).<sup>21</sup> Implementing newborn hearing screening programmes in low- and middle-income countries would improve the early diagnosis and treatment of sensorineural hearing loss. High-quality ENT training for professionals, accessible primary healthcare services, and up-to-date technology could prevent unsafe prescribing of ototoxic medication and allow disease to be identified at an early stage.<sup>18,19,22–24</sup> Early disease identification would reduce the prevalence of CSOM-associated complications that occur more frequently in prolonged and untreated disease (odds ratio = 1.03, 95 per cent CI = 1.007–1.05;  $p = 0.01$ ).<sup>21</sup>

Minimising noise exposure is essential.<sup>19,24</sup> In the UK, the Control of Noise at Work Regulations (2005) ensure that employers reduce occupational noise to prevent it impairing their employees' hearing.<sup>25</sup> Pressure must be put on low- and middle-income countries' governments to create similar legislation, which is often lacking. If environments and occupations cannot be altered, personal protective equipment must be available.<sup>19</sup>

Low- and middle-income countries carry a larger proportion of disabling hearing loss than developed countries, but the care available is minute in comparison.<sup>26,27</sup> Although some progress has been made over the last decade to expand primary care health services in low- and middle-income countries, with a focus on educating local people in the effective management of ear diseases, accessing high-quality care remains very difficult.<sup>26–28</sup>

### Diseases of nose, pharynx and larynx

A prospective cohort study assessed the burden of ENT disease in low- and middle-income countries.<sup>27</sup> Roughly 2600 patients were assessed and followed up for three years, all of whom presented to secondary care out-patient departments and health-care camps in an Indian farming community with a high rate of poverty. All diagnoses were made by trained professionals, who decided whether a referral to ENT services was indicated.

Roughly 8 per cent of patients had a nasal disorder, 50 per cent attributable to acute rhinitis, likely due to working in masonry, with paint, and around dust.<sup>27</sup> Seasonality showed an increasing incidence in winter. Eight per cent had recurrent sinusitis, becoming chronic in all patients after three years or

less. Ten per cent of patients had nasal polyposis requiring surgery.

Nineteen per cent of those patients with swallowing difficulties or hoarseness had chronic laryngitis, and tonsillitis caused 49 per cent of throat pain cases.<sup>27</sup> Iron deficiency is epidemic in many low- and middle-income countries due to diet, worm infections, malaria and poor antenatal care.<sup>29</sup> As a result, Plummer–Vinson syndrome – a triad of iron deficiency, atrophic glossitis, and oesophageal webs or strictures – was diagnosed in 23 per cent of those with swallowing difficulty.<sup>27</sup>

### Air pollution in low- and middle-income countries

Air pollution is the contamination of any environment by substances (chemical, biological or physical) that modify its natural characteristics.<sup>30</sup> With in-depth knowledge of the adverse effects of air pollution, developed countries have made successful efforts to reduce levels.<sup>31</sup> This is not the case in low- and middle-income countries. As industry expands, air pollution rises, and efforts to decrease levels have either minimally reduced them or they have remained static.<sup>31</sup>

Previous research has demonstrated a positive correlation between disease incidence and the concentration of air pollutants. Respiratory and cardiovascular diseases are particularly affected, with greater morbidity and mortality occurring with increased air pollution.<sup>31</sup> Nitrogen dioxide and sulphur dioxide affect the upper airway and middle ear, causing inflammation, irritation and infection.<sup>32,33</sup> Higher levels of air pollution are associated with an increased incidence of head and neck cancer.<sup>34,35</sup>

A study in Beijing evaluated the influence of air pollution on otolaryngology out-patient attendance.<sup>33</sup> Nitrogen dioxide and sulphur dioxide concentrations showed positive associations with out-patient attendance.<sup>33</sup> Exposure to air pollution early in life increases the risk of both upper and lower respiratory tract infections in children, including middle-ear infection.<sup>36,37</sup> Exposure to a combination of pollutants accelerates the onset of allergic rhinitis, particularly by inducing exacerbations.<sup>33</sup> These findings are consistent with conclusions made in numerous other studies.<sup>36–38</sup>

Data detailing the influence of air pollution on ENT diseases are limited. Higher air pollutant concentrations in developing countries may suggest that low- and middle-income countries suffer a greater air pollution associated ENT disease burden than high-income countries. Further research is required for confirmation.

### Head and neck cancer

Head and neck cancer is the sixth most common cancer type worldwide.<sup>39</sup> Two-thirds of the global burden of head and neck cancer occur in low- and middle-income countries, and the Indian subcontinent alone is responsible for one-third of lip and oral cavity cancers.<sup>35</sup>

The incidence of head and neck cancers is increasing across the world, particularly in women, which is likely due to increased alcohol and tobacco use, and improved diagnostic capabilities.<sup>35,40</sup> Alcohol and tobacco use remain the greatest risk factors for laryngeal cancer. Tobacco primarily influences disease at the vocal folds and glottis, and alcohol mainly in the supraglottic region. Synergism is evident between head and neck cancer risk factors, particularly tobacco use (smoking

and smokeless), gutka chewing (as it contains areca nut), alcohol consumption and oral human papillomavirus (HPV) infections.<sup>41</sup>

### Smoking

Over the last 10 years, tobacco use has increased by 2–3 per cent each year in India, and is expected to be responsible for 13 per cent of all deaths per year there by 2020.<sup>42</sup> In low- and middle-income countries, cancer of the oral cavity and throat is one of the commonest causes of death. The Aizawl district in India has the highest incidence of pharyngeal and tongue cancer in the world, affecting 11.5 and 7.6 per 100 000 population respectively.<sup>39</sup>

### Alcohol

In most low- and middle-income countries, alcohol is consumed infrequently but heavily.<sup>43</sup> Moderate and heavy alcohol use increases the risk of cancer, including cancer of the larynx. A systematic review demonstrated a risk-ratio of 1.44 (95 per cent CI = 1.25–1.66) for moderate consumption and 2.65 (95 per cent CI = 2.19–3.19) for heavy consumption.<sup>43,44</sup> Through lack of education, low- and middle-income countries' inhabitants are less aware of alcohol's negative consequences, and alcohol cessation strategies tend to fail.<sup>43</sup>

### Air pollution and head and neck cancer

High levels of air pollutants are associated with an increased risk of developing head and neck cancer.<sup>34</sup> Seventy-four per cent of the Indian population relies on solid fuels, greatly contrasting with that of high-income countries. For instance, in April 2017, Britain generated all electricity without using any coal.<sup>45</sup> The use of coal in India continues to increase, rising at a rate of 2.8 per cent each year.<sup>34,46</sup>

A retrospective case–control study investigated exposure to air pollution from solid fuels as a risk factor for laryngeal and hypopharyngeal cancer.<sup>34</sup> Exposure to burning coal indoors for over 50 years increased the risk of developing hypopharyngeal cancer (odds ratio = 3.47, CI = 0.95–12.69) and laryngeal cancer (odds ratio = 3.65, CI = 1.11–11.93).<sup>34</sup> Other solid fuels, such as wood, increased the risk of hypopharyngeal cancer too (odds ratio = 1.62, CI = 1.14–2.32), but not in never-smokers.<sup>34</sup>

### Human papillomavirus and head and neck cancer

Human papillomavirus is present in 50 per cent of squamous cell carcinomas of the head and neck, particularly affecting the tongue and tonsils.<sup>39</sup> Changing oral sexual practices and the presence of high-risk HPV genotypes have increased the frequency of HPV-associated head and neck cancers in low- and middle-income countries. These particularly affect younger patients and are not sex-specific.<sup>39</sup> Human papillomavirus is present in 16 per cent of oral and laryngeal cancers in high-income countries; this rate is lower than in low- and middle-income countries, especially India where prevalence ranges from 33.6 per cent to 67 per cent.<sup>47</sup>

By understanding the biology of HPV-associated cancers, there is no reason to suggest that the HPV vaccine's protective properties would differ in efficacy between head and neck cancer and anogenital cancer.<sup>48</sup> Human papillomavirus vaccinations for genotypes 16 and 18 could prevent over 90 per

cent of HPV-associated oropharyngeal cancers, supporting the argument that males should be vaccinated too, owing to their higher risk for HPV-associated head and neck cancer.<sup>48,49</sup>

Human papillomavirus vaccines are widely available in high-income and some middle-income countries. Although one of the most cost-effective methods for disease prevention, vaccines are rarely available in low-income countries.<sup>50,51</sup> For vaccines to become widely available, financial subsidies must be provided. Recently, Ministries of Health and non-governmental organisations have used donated vaccinations to try and improve conditions.<sup>50</sup> Although a worthwhile effort, governmental and international projects are essential; otherwise, HPV-associated head and neck cancer rates are unlikely to fall.

### Head and neck cancer care in developing world

Steps must be taken to both prevent and manage head and neck cancer in low- and middle-income countries. Primary preventative initiatives such as international media campaigns to raise awareness of the current head and neck cancer crisis, taxing tobacco and alcohol use, designating smoke-free areas, vaccinations, ventilation for buildings, and safe-sex programmes are essential. Secondary prevention by appropriately training professionals to manage head and neck cancers, and encouraging smoking cessation, would also be of great value.

### Climate change and ENT

Since the beginning of the industrial revolution, humans have released gases into the lower atmosphere that trap energy and contribute to global warming by amplifying the Earth's natural greenhouse effect.<sup>52</sup> As the Earth continues to warm, our climate changes, and its effect on human life and health already is evident.

Climate change has been referred to as one of the greatest risks to human health, and between 2030 and 2050 it is predicted to cause around 250 000 deaths per year.<sup>53</sup>

Climate change's health impact will be felt across the globe, most prominently in low- and middle-income countries. Low- and middle-income countries already have weak health infrastructures, particularly for ENT services, and damage through loss of land and overcrowding, for example, will impair their ability to cope.<sup>53</sup> Changes in air pollution and aeroallergen concentrations will affect otorhinolaryngological disease, and altering the distribution of vector organisms will predispose individuals to infectious diseases, including nasopharyngeal, ear and paediatric airway diseases.<sup>3,52,54</sup>

### Improving ENT global health

The ENT disease burden predominates in developing countries, and is unfortunately a prime example of the inverse care law in action. Although not to the same extent as in developed countries, the population in low- and middle-income countries is ageing. With ageing comes an increased disease burden, greater demands on health services, treatment rationing and longer waiting times.

Although interventions such as an ENT training programme established in sub-Saharan Africa showed promise, there was minimal improvement in the population's ENT-related health, as the community's population grew at a rate that overwhelmed new services after just six years.<sup>55</sup> Improved education and communication, humanitarian

efforts, and the introduction of self-sustaining healthcare infrastructures are necessary to reduce the global burden of ENT diseases.

### Education and communication

Both public and healthcare staff in low- and middle-income countries are insufficiently educated in the prevention, diagnosis, treatment and rehabilitation of ENT disease. Public behaviours increase the population's risk of disease, but healthcare is insufficient in quality and quantity.<sup>56</sup> This is a result of poor local training and the migration of professionals.<sup>56</sup> Therefore, low- and middle-income countries become dependent on the importation of external practitioners who they cannot afford.<sup>56</sup> International bodies must help to fund training programmes for local people, as done rather successfully in Malawi by Mulwafu *et al.*<sup>28</sup> Being trained to deliver preventative healthcare, such as vaccinations and contraception, is paramount.

Innovative low-cost methods for training are needed. Clark *et al.*<sup>57</sup> developed an Ear Trainer for low-resource settings, which recently has been validated as a realistic representation of the ear for microsurgical training. GoogleGlass is a company that has streamed live surgical operations online using a camera attached to spectacles.<sup>58</sup> In 2014, its first operation was live-streamed to 13 000 surgical students from 115 different countries. Students had their questions answered by the surgeon in real-time, representing a cornerstone in transnational education, and providing promise for future training in low- and middle-income countries.<sup>59</sup>

Telemedicine, the use of electronic information and technology to provide healthcare when distance separates the patient from the professional, should be utilised as an affordable way to communicate with, and provide care to, low- and middle-income countries, which often have limited transport opportunities.<sup>60,61</sup>

### Humanitarian efforts

Although most aid is provided vertically, when trying to establish a sustainable healthcare system, horizontal aid should predominate.<sup>62</sup> Financial co-operation from multiple bodies is required to establish a sustainable healthcare system in low- and middle-income countries. Independent donors, universities, ministries, and both governmental and non-governmental organisations must contribute, so that healthcare professionals can be recruited and resources made available.<sup>63</sup>

### Healthcare infrastructure

A sustainable healthcare system requires robust financing, a well-trained workforce who are paid adequately, an evidence-base to assist in decision-making, technology able to diagnose and treat disease, and a system to deliver medicine and technology to patients.<sup>56</sup> Most low- and middle-income countries' healthcare systems underachieve in all these categories, for a variety of reasons.<sup>56</sup>

In order to maximise the population's health for the lowest cost, most funding should target high-quality primary care service provision, with a focus on disease prevention.<sup>19,64,65</sup> This is difficult to implement, however, as privately-run services often provide treatment for established disease and thus prevention strategies are of little interest.

The role of non-governmental organisations is not simply to 'fill gaps' in healthcare; they can provide large-scale innovative health programmes.<sup>66</sup> But non-governmental organisations face challenges. They are dependent on donors, they usually lack a strategic plan and they often have conflicting political governance. Governments are usually focused on public popularity with short-term objectives. Along with other political motives such as pressure from big businesses (pharmaceutical, tobacco and alcohol), convincing governments to prioritise a long-term commitment towards establishing an effective disease prevention strategy is challenging.

## Conclusion

People living in low- and middle-income countries are more likely to develop ENT diseases, and are less likely to receive adequate care. Geographical, social, economic and political factors all contribute to the disparity between low- or middle-income countries and high-income countries. ENT is a rapidly developing surgical specialty that prides itself on innovative changes which improve the prevention, diagnosis, treatment and rehabilitation of patients. However, such advancements are unavailable in low- and middle-income countries, and this directly exacerbates the imbalance of care.

In order to improve patient care in low- and middle-income countries, a multifaceted approach must be adopted. Public health interventions must be heightened to educate the local community and prevent diseases, efforts to encourage the development of robust primary care services must be made, and native healthcare professionals must receive high-quality ENT education so sustainable and low-cost care can be provided without constant external input. Finally, to prevent governments from solely focusing on short-term health objectives, it is essential that they are pressured to prioritise the funding of long-term, sustainable health programmes which focus on both preventing and managing ENT diseases.

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