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SNORING – AN ALARMING INDICATOR OF CARDIOVASCULAR RISK- A REVIEW

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ABSTRACT

Snoring has been a common habit of many of them irrespective of age, sex and may or may not depict a chronic problem. Snoring is caused by inadequate space for the tongue in the back of the throat and poor muscle tone in the muscles of tongue and throat, long soft palate and uvula. Snoring is a result of partial collapse of the upper respiratory tract during sleep causing a noisy breathing. Whatever be the cause of snoring, the type of sound varies and the effects are also comparable. Primary snoring is a loud inspiratory sound without episodes of apnea. This is caused by turbulence in the air flow causing narrowed nasopharyngeal and oropharyngeal spacing. Another type is a habitual snore caused by upper airway obstruction with increased respiratory effort. These episodes may occur every night or once a week and irrespective of any body position. Snoring may often be associated with a sleep disorder called obstructive sleep apnea (OSA). The underlying mechanisms explained in this association between OSA and CAD are constant oxidative stress and sympathetic activation and changes in intra thoracic pressure, endothelial damage with activation of coagulation factors and platelets. Animal studies reported that IH mediated inflammation and damage is an important factor that mediates development of pre-atherosclerotic lesions. The most common and popular nonsurgical interventional therapy towards OSA is the mandibular repositioning device, tongue retaining devices and Continuous positive airways pressure and some surgical interventions are useful.

INTRODUCTION

Snoring is a harsh and a hoarse sound caused by vibration of tissues around the throat when a person is breathing in his sleep. Snoring has been a common habit of many of them irrespective of age, sex and may or may not depict a

chronic problem. (Website, no date a) This habit of snoring may be predisposing due to changes in lifestyle changes, obesity, genetic factors, pregnancy, nasal congestion, allergies, deformities like deviated nasal septum, even sleeping positions, habits like alcohol, smoking and intake of certain drugs and medications. (Website, no date a, Website, no date b)

SNORING AND ASSOCIATED DISORDERS

Snore is caused by inadequate space for the tongue in the back of the throat and poor muscle tone in the muscles of tongue and throat, long soft palate and uvula. This is common in people who are obese and suffer from cardiovascular problems. Due to inadequate breathing, there is improper oxygenation to the brain and other tissues. This indirectly increases the surge of cortisone, adrenaline, noradrenaline and other hormones. This hormonal surge can further exacerbate damage to brain and heart, thus triggering heart attacks, fibrillations of the heart, stroke and even death. (Website, no date c)

Snoring may not only be a bed time annoyance, but poses the risk for many disorders in the body. OSA being the common type of sleep apnea occurs when the pharyngeal muscles intermittently relax and blocks the upper airway. OSA causes respiratory gasps, dry mouth with head ache and irritability in the mornings, but loud snore is a common sign of OSA (Website, no date c, Website, no date d)

SNORING AND OSA

Snoring is a result of partial collapse of the upper respiratory tract during sleep causing a noisy breathing. Snoring may often be associated with a sleep disorder called obstructive sleep apnea (OSA). It is not a condition that every snorer is supposed to have. OSA is characterized by loud snoring in between periods of paused breaths when sleeping at night. A person who is witnessed to have snoring with OSA would develop paused breathing during his sleep, gasping for breath at night, restless sleep at night, excessive day time sleeping, chest pain in the morning, high blood pressure, inability to concentrate, poor attention and behavioural problems.

Snoring is a sign that increases the risk of diabetes mellitus, hypertension, stroke, heart attack and other cardiovascular problems. A study investigated by the Radiological society of North America worked on the association of OSA and snoring with cardiovascular risk. They observed that left ventricular dysfunction is more common and rarely right ventricular dysfunction in women compared to men.

Another study conducted among participants of UK Biobank and MRI of the heart and cardiac tissues were done. The participants were categorized as participants with OSA; participants self reported as snorers; participants not affected by OSA or snoring. The study observed that there was an increase in left ventricular mass caused by left ventricular hypertrophy. (Website, no date e)

Another study investigated the association between snoring and hypertension irrespective of having OSA. The participants were assessed for one night polysomnographic sleep parameters and assessment of apnea and snoring.

After they woke up, they were assessed for their resting blood pressure every 15 mins. Hypertensive state with BP $\geq 140/90$ mmHg was strongly associated with snoring and apnea. The study concluded that snoring was a vigorous predictor of hypertension. (Website, no date e; Khazaie *et al.*, 2019)

Individuals with OSA and snoring have reported to suffer from medical problems and Ischemic heart disease which happens to be the main diagnostic index of OS (Svensson *et al.*, 2008; Sadeghniaat-Haghighi *et al.*, 2015; Baguet *et al.*, 2016).

A study by Baguet conducted on 169 patients reported that the habit of snoring was greatly associated with increased diameter of the root of diameter among hypertensive patients. (Baguet *et al.*, 2006)

OSA is also observed as a cause of secondary hypertension that is associated with potential tissue damage in all the organs. The resultant hypertension caused by acute autonomic and haemodynamic changes produces repeated arousal and intermittent hypoxia during sleep. OSA also predisposes to imbalance to autonomic nervous systems characterized by overaction of sympathetic system with exaggerated baroreflex mechanisms and vascular dysfunction. These changes are due to oxidative stress and inflammatory response. (Deleanu *et al.*, 2014) (Cano-Pumarega *et al.*, 2011; Deleanu *et al.*, 2014)

Snoring also happens to be an important indicator of poor health, increased body weight and behavioural problems as well. Studies in children also associated OSA with sleep apnoea syndrome. Children affected with OSA increased the developed hypertension and cardiovascular problems (Cano-Pumarega *et al.*, 2011; Weber *et al.*, 2012; Deleanu *et al.*, 2014)

Another observational study investigated on the aspect that frequent snoring is a predictor of stroke and coronary artery disease (CAD) among 42,244 women. The participants were post menopausal women who self reported on snoring habits were confirmed on diagnosis for CAD, Myocardial infarction and ischemic stroke. Results claimed that frequent snoring is associated with 95% incidence of CHD, 95% stroke, 95% of CVD in women. Thus they concluded that snoring acts as an important risk factor to develop ischemic diseases of the brain and heart. (Website, no date f)

It has also been demonstrated by previous research finding that habitual snoring is greatly associated with obesity and higher BMI. Thus may be one of the factors that associate with cardiovascular risk in women. Also the fact that hormonal support offered by estrogen becomes very much reduced after menopause among older female population (Leineweber *et al.*, 2003)

Another explanation supporting this association is that Snoring may induce atherosclerosis of the arteries. The upper airway resistance and vibrations felt in the pharyngeal wall may result in endothelial dysfunction and atherosclerosis of carotid arteries in animal models like rabbits. And that heavy frequent snoring also causes increased thickness of tunica intima and plaque deposition on the carotid arteries and its bifurcation (Leineweber *et al.*, 2003; Lee *et al.*, 2008; Cho *et al.*, 2011)

ASSOCIATION BETWEEN OSA AND CARDIOVASCULAR HEALTH

According to Filipinos, snoring happens to be a sign of good quality of a deep sleep. But, instead people who snore are profound to develop many disorders. Snore during sleep pauses breathing for some time due to airway collapse and prevents air entry into the lungs. This pause of breaths can increase for more than 30 times per hour, so that it predisposes to cardiovascular heart disease. (*Website*, no date g)

A study conducted by researchers among participants who were male with age above 46 years frequent snorers who experienced apnea and respiratory choking and systolic BP 130-150 mm Hg and diastolic BP 80-100 mmHg. They used a Modified Berlin Snoring Inventory and BP determination to determine the characteristics of post wake up. Results found that a significant difference in disturbance after post wake up with an increase in diastolic BP and a feeling of tiredness. (Masa, 2019)

Another review explains that cases of sudden death after sleep have been reported as untreated sleep apnea prone to develop arrhythmias. This risk of arrhythmias is generally associated with snoring and hypertension as per previous research reports. Sleep apnea is a very important risk factor of hypertension. The systolic blood pressure increases at the end apnea and diastolic pressure increases during apnea. The resultant hypoxaemia being greater, greater the systolic and diastolic blood pressure. (*Website*, no date h)

The deprivation of oxygen occurs each pause breath. This breath holding gradually increases from 10 secs and progresses to 20 to 30 seconds. Each episode repeats several times, that is about 20 to 100 times per hour for the whole night and each cycle is accompanied by respiratory gasps. (Gangwisch *et al.*, 2014)

A review study explained that OSA increased the risk of coronary artery disease (CAD), stroke and heart failure. Such patients when treated with continuous positive airway pressure improves cardiac functions like good left ventricular function, decreases the BP and decreases the platelet activation. The underlying mechanisms explained in this association between OSA and CAD are constant oxidative stress and sympathetic activation and changes in intra thoracic pressure, endothelial damage with activation of coagulation factors and platelets. (Jean-Louis *et al.*, 2008; Gangwisch *et al.*, 2014)

OSA leads to cardiovascular disease through many possible mechanisms called pathobiological triggering factors in cardio pulmonary haemodynamics. These factors are sleep fragmentation, intermittent hypoxia and intermittent swings in the intra thoracic pressures. Intermittent hypoxia (IH) is common in OSA due to repetitive desaturation and oxygenation caused by paused breaths during sleep. (Kent, Ryan and McNicholas, 2011). Animal studies reported that IH mediated inflammation and damage is an important factor that mediates development of pre-atherosclerotic lesions (Levy *et al.*, 2013)

Intermittent hypoxia generates sympathetic activation and enhances endothelial dysfunction and develops atherosclerosis and hypertension. The attributed cause of this IH is dysfunction of adipose tissue and increased risk

of type -2 Diabetes mellitus.(Kent, McNicholas and Ryan, 2015)). IH increases oxidative stress and raises the production of reactive oxygen species, thus producing atherosclerosis and endothelial dysfunction (Lavie and Lavie, 2009)

Thus patients with known OSA who are receiving Continuous Positive Airways pressure have substantially good oxygen delivery at night and if CPAP is discontinued there was significant elevation of BP in the early mornings. (Turnbull *et al.*, 2019)

NATURAL DEFECTS IN UPPER RESPIRATORY AIRWAY

Anatomically pharynx is considered as the common site of airway obstruction because it lacks bony and cartilaginous support. (Ayappa and Rapoport, 2003; Jones *et al.*, 2013; Turnbull *et al.*, 2019) . Mechanical factors like compliance and lung volume, body position, surface- adhesiveness and fluid elasticity of mucosa, vascular tone of blood vessels and neural factors like sympathetic and parasympathetic response of the airways contribute to affect the patency and collapsing tendency of the airways. But the common sites of obstruction are retropalatal (100% obstruction), retroglossal (50% obstruction) and hypopharyngeal regions (10% obstruction) (Hudgel *et al.*, 1998; Isono, Tanaka and Nishino, 2003)

OTHER CAUSES OF SNORING

In OSA , **snoring** seems to follow a cycle with loud snore followed by periods of silence. This alternatively opens the airway to let the breath in . This loud snore that opens the airway to resume the breath is called a “resuscitative snort” (Liam , 1999). Obstruction to the airway like shrinkage of air passage in bronchial asthma, anatomical deviations caused by tumor, large adenoids or tonsils or a large uvula and polyps can also produce a snore. (Pataka and Riha, 2013)

TYPES OF SNORE

Whatever be the cause of snore, the type of sound varies and the effects are also comparable. Primary snoring is a loud aspiratory sound without episodes of apnea. This is caused by turbulency in the air flow caused narrowed nasopharyngeal and oropharyngeal spacing. (Bradley & Floras, 2009). Another type is a habitual snore caused by upper airway obstruction with increased respiratory effort. these episodes may occur every night or once a week and irrespective of any body position. (Young, Finn and Palta, 2001; Pataka and Riha, 2013)(Stoohs and Guilleminault, 1991)

COMPLICATIONS OF SNORING HABITS

Although snoring poses a risk of cardiovascular problems and stroke, it also influences the other organ systems as well. The short term effects of snore may be intermittent hypoxemia, and hypercapnia and sleep fragmentation and arousals. The long-term complications of snore are more related to respiratory and cerebrovascular and cardiovascular diseases. People with sleep apnea always keep the mouth and throat open and contents of stomach regurgitate into the esophagus, so they are bound to develop heart burn or gastroesophageal reflux disease and Polycystic-Ovary Syndrome. Snoring affects the quality of sleep. This develops head ache, irritability, mental

confusions and mental depression (*Website*, no date i, *Website*, no date j). Snoring also serves to indicate disorders like pre-eclampsia and foetal-growth-restriction. (Franklin *et al.*, 2000)..Obstructed breathing caused by snore associated with sleep apnoea can also pose respiratory failure and cor pulmonale during day time. ('Griffin, Liam, (born 9 March 1973), Vice Chairman, Addison Lee Ltd, since 2015', 2015)Disturbances to spouse at sleep have also led to severe marital conflicts in personal life and even divorce.

Studies also observed that snorers could be able to generate more negative inspiratory pressures, prolong inspiratory time and limit the respiratory air flow. These respiratory changes are pathological exaggerations that occur during sleep. It has also been observed that snoring becomes in the early night sleep and becomes worse in slow wave sleep but rare during REM sleep.(Skatrud and Dempsey, 1985; Perez-Padilla *et al.*, 1987; Stoohs and Guilleminault, 1991)

GENDER DIFFERENCES IN SNORE

The prevalence of snoring tend to increase with age and peaks about in the age group of 50-60 years. The incidence is such that habitual snoring is common in 25% women and 46% male and the trend seems to increase from 30 -70 yrs in a study conducted in Spain. In the UK, the incidence is that 33.6% of females and 47.7% of males are habitual snorers. This percentage increased in about 97% in patients with sleep apnoea. (Whyte *et al.*, 1989)

Men are prone to have snoring habit compared to women. Men have genetically narrower airways and that can cause unpleasant snore at night time. The air passage getting more narrower, the more the reduction of oxygen flow to the lungs and this creates a vibration around the tissues of the throat. The frequency of alcohol intake can also promote the tendency to snore.

Females also have the habit of snoring because weight gain caused by hormonal imbalance, expanded blood vessels around nasal cavity during pregnancy, relaxation of laryngeal muscles after too much exhaustion, reduced muscle tone around the throat after menopause (*Website*, no date k)

Excessive day time sleepiness is the effect of post snoring on the next day. Other effects of post snore are dry mouth, dry throat, fatigue and memory deficits, poor attention and concentration. The disruption of circadian rhythm in turn increases the risk of vascular changes, risk of cardiovascular disease, stroke and congestive heart disease. (*Website*, no date l)

NATURAL SOLUTIONS FOR SNORE

Some of the natural solutions and life style changes that can be opted for prevent snoring during sleep. Change in the position of sleep – side lying can be the best position. Supine position can cause the soft palate and base of tongue to fall back on the throat, producing this crowing sound called snore.

Weight gain around neck squeezes the internal diameter of throat and alcohol intake decreases the resting tone of muscles around throat, thus triggering snore. So, a proper weight control can prevent such complication. Cleanliness around the bed can prevent snore as the allergens around bed can cause snore (*Website*, no date l, *Website*, no date m)

NON SURGICAL INTERVENTIONS

The most common and popular nonsurgical interventional therapy towards OSA is the mandibular repositioning device (MRD). Studies who profoundly used MRD with apnea hypopnea index 10 showed a significant improvement with index 8 to 6 and the proportion of snores became relatively less from 28% to 9% (O'Sullivan). But compared to CPAPs, MRDs seems to be less effective and greater side effects like bite change, dental pain and temporomandibular joint and myofascial pains. Tongue retaining devices also work similar to MRDs by holding the anterior part of the tongue forward. Nasal CPAP are 100% most effective in this therapy which is observed to reduce the number of snores from 154 to 3 per hour. (Johnston et al, 2001). Pioneering surgeries like uvulopalatopharyngoplasty (UPPP) and laser assisted uvulopalatoplasty can also help as treatment of OSA (Diana Starovoytova et al, 2008)

CONCLUSION

Snoring being a common problem faced by many people irrespective of age, sex and may depict a chronic problem in the body. An inadequate breathing during a snore are caused by episodes of apnea. This may result from poor muscle tone of the muscles around the throat. The intermittent hypoxia causes potential damage to the brain and heart and produces a threat to stroke, coronary artery disease, hypertension, early morning headache, irritability, confusion etc. So this problem should be given utmost consideration and seek medical help. Use of non surgical appliances can serve to reduce the tendency to snore, but side effects still prevail.

REFERENCES

- Ayappa, I. and Rapoport, D. M. (2003) 'The upper airway in sleep: physiology of the pharynx', *Sleep medicine reviews*, 7(1), pp. 9–33.
- Baguet, J. P. et al. (2006) 'P352 Masked hypertension and obstructive sleep apnea syndrome (OSAS)', *Sleep Medicine*, p. S67. doi: 10.1016/j.sleep.2006.07.161.
- Baguet, J.-P. et al. (2016) 'Snoring but not sleepiness is associated with increased aortic root diameter in hypertensive patients. The SLEEPART study', *International journal of cardiology*, 202, pp. 131–132.
- Cano-Pumarega, I. et al. (2011) 'Obstructive Sleep Apnea and Systemic Hypertension', *American Journal of Respiratory and Critical Care Medicine*, pp. 1299–1304. doi: 10.1164/rccm.201101-0130oc.
- Cho, J.-G. et al. (2011) 'Tissue vibration induces carotid artery endothelial dysfunction: a mechanism linking snoring and carotid atherosclerosis?', *Sleep*, 34(6), pp. 751–757.
- Deleanu, O.-C. et al. (2014) 'Obstructive sleep apnea syndrome and arterial hypertension--a complicated relationship? The role of controlling blood pressure values in patients with OSAS', *Pneumologia*, 63(1), pp. 36–43.

- Diana Starovoytova .Snoring and Its-management (Part 1/2): A Review. *Innovative Systems Design and Engineering*. 2018; 9 (2): 1-16
- Franklin, K. A. et al. (2000) 'Snoring, pregnancy-induced hypertension, and growth retardation of the fetus', *Chest*, 117(1), pp. 137–141.
- Gangwisch, J. E. et al. (2014) 'Daytime sleepiness and risk of coronary heart disease and stroke: results from the Nurses' Health Study II', *Sleep Medicine*, pp. 782–788. doi: 10.1016/j.sleep.2014.04.001.
- 'Griffin, Liam, (born 9 March 1973), Vice Chairman, Addison Lee Ltd, since 2015' (2015) Who's Who. doi: 10.1093/ww/9780199540884.013.u283649.
- Hudgel, D. W. et al. (1998) 'Instability of ventilatory control in patients with obstructive sleep apnea', *American journal of respiratory and critical care medicine*, 158(4), pp. 1142–1149.
- Isono, S., Tanaka, A. and Nishino, T. (2003) 'Dynamic interaction between the tongue and soft palate during obstructive apnea in anesthetized patients with sleep-disordered breathing', *Journal of applied physiology*, 95(6), pp. 2257–2264.
- Jean-Louis, G. et al. (2008) 'Obstructive Sleep Apnea and Cardiovascular Disease: Role of the Metabolic Syndrome and Its Components', *Journal of Clinical Sleep Medicine*, pp. 261–272. doi: 10.5664/jcsm.27191.
- Jones, A. et al. (2013) 'Arterial stiffness and endothelial function in obstructive sleep apnoea/hypopnoea syndrome', *Sleep Medicine*, pp. 428–432. doi: 10.1016/j.sleep.2013.01.001.
- Kent, B. D., McNicholas, W. T. and Ryan, S. (2015) 'Insulin resistance, glucose intolerance and diabetes mellitus in obstructive sleep apnoea', *Journal of thoracic disease*, 7(8), pp. 1343–1357.
- Kent, B. D., Ryan, S. and McNicholas, W. T. (2011) 'Obstructive sleep apnea and inflammation: Relationship to cardiovascular co-morbidity', *Respiratory Physiology & Neurobiology*, pp. 475–481. doi: 10.1016/j.resp.2011.03.015.
- Khazaie, H. et al. (2019) 'Among Middle-Aged Adults, Snoring Predicted Hypertension Independently Of Sleep Apnoea', *Sleep Medicine*, p. S192. doi: 10.1016/j.sleep.2019.11.532.
- Lavie, L. and Lavie, P. (2009) 'Molecular mechanisms of cardiovascular disease in OSAHS: the oxidative stress link', *The European respiratory journal: official journal of the European Society for Clinical Respiratory Physiology*, 33(6), pp. 1467–1484.
- Lee, S. A. et al. (2008) 'Heavy snoring as a cause of carotid artery atherosclerosis', *Sleep*, 31(9), pp. 1207–1213.
- Leineweber, C. et al. (2003) 'Snoring and the metabolic syndrome in women', *Sleep medicine*, 4(6), pp. 531–536.
- Levy, P. et al. (2013) 'Sleep apnoea and the heart', *European Respiratory Review*, pp. 333–352. doi: 10.1183/09059180.00004513.
- Masa, R. A. Z. (2019) 'SNORING CHARACTERISTICS INVENTORY AND BLOOD PRESSURE: WINDOW ASSESSMENT TOOL FOR OBSTRUCTIVE SLEEP APNEA AND CARDIOVASCULAR RISK', *Malaysian Sports Journal*, pp. 01–05. doi: 10.26480/msj.02.2019.01.05.

- Pataka, A. and Riha, R. L. (2013) 'Continuous positive airway pressure and cardiovascular events in patients with obstructive sleep apnea', *Current cardiology reports*, 15(8), p. 385.
- Perez-Padilla, J. R. et al. (1987) 'Snoring in Normal Young Adults: Prevalence in Sleep Stages and Associated Changes in Oxygen Saturation, Heart Rate, and Breathing Pattern', *Sleep*, pp. 249–253. doi: 10.1093/sleep/10.3.249.
- Sadeghniaat-Haghighi, K. et al. (2015) 'The STOP-BANG questionnaire: reliability and validity of the Persian version in sleep clinic population', *Quality of Life Research*, pp. 2025–2030. doi: 10.1007/s11136-015-0923-9.
- Skatrud, J. B. and Dempsey, J. A. (1985) 'Airway resistance and respiratory muscle function in snorers during NREM sleep', *Journal of Applied Physiology*, pp. 328–335. doi: 10.1152/jappl.1985.59.2.328.
- Stoohs, R. and Guilleminault, C. (1991) 'Snoring during NREM sleep: Respiratory timing, esophageal pressure and EEG arousal', *Respiration Physiology*, pp. 151–167. doi: 10.1016/0034-5687(91)90058-q.
- Svensson, M. et al. (2008) 'Daytime Sleepiness Relates to Snoring Independent of the Apnea-Hypopnea Index in Women From the General Population', *Chest*, pp. 919–924. doi: 10.1378/chest.08-0847.
- Turnbull, C. D. et al. (2019) 'Effect of Supplemental Oxygen on Blood Pressure in Obstructive Sleep Apnea (SOX). A Randomized Continuous Positive Airway Pressure Withdrawal Trial', *American Journal of Respiratory and Critical Care Medicine*, pp. 211–219. doi: 10.1164/rccm.201802-0240oc.
- Weber, S. A. T. et al. (2012) 'Ambulatory blood pressure monitoring in children with obstructive sleep apnea and primary snoring', *International Journal of Pediatric Otorhinolaryngology*, pp. 787–790. doi: 10.1016/j.ijporl.2012.02.041.
- Website (no date a). Available at: 1. <https://www.mayoclinic.org/diseases-conditions/snoring/symptoms-causes/syc-20377694> (Accessed: 1 August 2020).
- Website (no date b). Available at: 2. <http://sleepeducation.org/essentials-in-sleep/snoring/causes-and-symptoms> (Accessed: 1 August 2020).
- Website (no date c). Available at: 3. <https://healthblog.uofmhealth.org/heart-health/how-chronic-snoring-can-cause-heart-disease#:~:text=Heavy%20snoring%20can%20sound%20funny,the%20condition%20is%20no%20joke.&text=Snoring%20is%20often%20the%20sign,attack%20and%20other%20cardiovascular%20problems>. (Accessed: 1 August 2020).
- Website (no date d). Available at: 4. <https://www.sciencedaily.com/releases/2018/11/181129084708.htm> (Accessed: 1 August 2020).
- Website (no date e). Available at: 5. https://press.rsna.org/timssnet/media/pressreleases/14_pr_target.cfm?ID=2055 (Accessed: 1 August 2020).
- Website (no date f).
- Website (no date g). Available at: 18. de los Reyes, V.S., Ojascastro, E.B., Ceniza, R.B., Dizon, R.V., Banzon, A.G., Jocson, M.C., Jorge, M.C., Remulla, A.T., Zaraspe, A.C. 2016. *Philippine Clinical Practice*

- Guidelines on the Diagnosis and Management of Obstructive Sleep Apnea in Adults, Philippine College of Physicians. Retrieved from: http://philchest.org/v3/wpcontent/uploads/2013/05/09_May_-final-draft-cpg-osa.pdf (Accessed: 1 August 2020).
- Website (no date h). Available at: 20. Endeshaw, Y., Rice, T.B., Schwartz, A.V., Stone, K.L., Manini, T.M., Satterfield, S., Cummings, S., Harris, T., Pahor, M. 2013. Snoring, daytime sleepiness, and incident cardiovascular disease in the health, aging, and body composition study. *SLEEP Research Society*, 36 (11), pp. 1737-1745. Retrieved from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3792392/> (Accessed: 1 August 2020).
- Website (no date i). Available at: 8. <https://www.alaskasleep.com/blog/dangers-of-snoring> (Accessed: 1 August 2020).
- Website (no date j).
- Website (no date k).
- Website (no date l).
- Website (no date m). Available at: 10. <https://www.webmd.com/sleep-disorders/features/easy-snoring-remedies> (Accessed: 1 August 2020).
- Whyte, K. F. et al. (1989) 'Clinical features of the sleep apnoea/hypopnoea syndrome', *The Quarterly journal of medicine*, 72(267), pp. 659–666.
- Young, T., Finn, L. and Palta, M. (2001) 'Chronic Nasal Congestion at Night Is a Risk Factor for Snoring in a Population-Based Cohort Study', *Archives of Internal Medicine*, p. 1514. doi: 10.1001/archinte.161.12.1514.
- Baguet, J. P. et al. (2006) 'P352 Masked hypertension and obstructive sleep apnea syndrome (OSAS)', *Sleep Medicine*, p. S67. doi: 10.1016/j.sleep.2006.07.161.
- Baguet, J.-P. et al. (2016) 'Snoring but not sleepiness is associated with increased aortic root diameter in hypertensive patients. The SLEEPART study', *International journal of cardiology*, 202, pp. 131–132.
- Cano-Pumarega, I. et al. (2011) 'Obstructive Sleep Apnea and Systemic Hypertension', *American Journal of Respiratory and Critical Care Medicine*, pp. 1299–1304. doi: 10.1164/rccm.201101-0130oc.
- Deleanu, O.-C. et al. (2014) 'Obstructive sleep apnea syndrome and arterial hypertension--a complicated relationship? The role of controlling blood pressure values in patients with OSAS', *Pneumologia*, 63(1), pp. 36–43.
- Khazaie, H. et al. (2019) 'Among Middle-Aged Adults, Snoring Predicted Hypertension Independently Of Sleep Apnoea', *Sleep Medicine*, p. S192. doi: 10.1016/j.sleep.2019.11.532.
- Sadeghniaat-Haghighi, K. et al. (2015) 'The STOP-BANG questionnaire: reliability and validity of the Persian version in sleep clinic population', *Quality of Life Research*, pp. 2025–2030. doi: 10.1007/s11136-015-0923-9.
- Svensson, M. et al. (2008) 'Daytime Sleepiness Relates to Snoring Independent of the Apnea-Hypopnea Index in Women From the General Population', *Chest*, pp. 919–924. doi: 10.1378/chest.08-0847.

- Weber, S. A. T. et al. (2012) 'Ambulatory blood pressure monitoring in children with obstructive sleep apnea and primary snoring', *International Journal of Pediatric Otorhinolaryngology*, pp. 787–790. doi: 10.1016/j.ijporl.2012.02.041.
- Website (no date a). Available at: 1. <https://www.mayoclinic.org/diseases-conditions/snoring/symptoms-causes/syc-20377694> (Accessed: 1 August 2020).
- Website (no date b). Available at: 2. <http://sleepeducation.org/essentials-in-sleep/snoring/causes-and-symptoms> (Accessed: 1 August 2020).
- Website (no date c). Available at: 3. <https://healthblog.uofmhealth.org/heart-health/how-chronic-snoring-can-cause-heart-disease#:~:text=Heavy%20snoring%20can%20sound%20funny,the%20condition%20is%20no%20joke.&text=Snoring%20is%20often%20the%20sign,attack%20and%20other%20cardiovascular%20problems>. (Accessed: 1 August 2020).
- Website (no date d). Available at: 4. <https://www.sciencedaily.com/releases/2018/11/181129084708.htm> (Accessed: 1 August 2020).
- Website (no date e). Available at: 5. https://press.rsna.org/timssnet/media/pressreleases/14_pr_target.cfm?ID=2055 (Accessed: 1 August 2020).