

Knowledge and Awareness on Obstructive Sleep Apnea and its Complications among Chennai Population

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ABSTRACT

Obstructive sleep apnea is one of the most common sleeping disorders. Difficulty in breathing occurs during sleep with a 'frequent phase' in the heartbeat. Several previous research has

concluded that OSA can increase the risk of memory problems. For example, dementia and Alzheimer's diseases. It is one of the highly prevalent conditions. Cognitive impairment occurs due to endothelial dysfunction. A number of population based studies have shown that obstructive sleep apnea is most common in men than women and it is concluded that there are several pathophysiological differences to explain men are more prone to the disease than women. The aim of the article is to impart knowledge and awareness about obstructive sleep apnea and it's an association with memory and cognitive skills. The study is to create knowledge and awareness about the obstructive sleep apnea. So a set of questionnaires is prepared which helps to provoke thoughts among young, adult, and aged male populations. The data are collected in the online portal and the statistical test is done using SPSS. As a result of the questionnaire knowledge and awareness have been given among male populations to maintain their cognitive and memory skills. Most of them are already aware of sleep apnea and more awareness is created by this article.

Key words: Obstructive sleep apnea, Alzheimer's disease, cognitive memory, male, awareness, sleep apnea syndrome.

INTRODUCTION

Obstructive sleep apnea is one of the most common sleeping disorders. It is characterized by intermittent complete and partial air wave collapse, resulting in frequent episodes of apnea and hypopnea. (Young, Skatrud and Peppard, 2004), (Ephros, Madani and Yalamanchili, 2010) universally, sleep disorders are classified into three syndromes they are central sleep apnea, obstructive sleep apnea syndrome, and sleep related hypoventilation/hypoxia syndrome (Yaggi, Klar Yaggi and Strohl, 2010) Studies suggest that there are several psychiatric symptoms such as depression and anxiety are commonly seen. (Andrews and Oei, 2004) it is also associated with an increase in intrathoracic pressure, hemodynamic disruption, and recurrent brain arousal with sleep fragmentation and cycles of hypoxia. (Farley *et al.*, 2006) studies suggest that these are the relationship between obstructive sleep apnea and Alzheimer's disease. Both of these disorders are highly prevalent in older people and are frequently seen together. (Emamian *et al.*, 2016) unfortunately, obstructive sleep apnea may further increase the risk of already existing Alzheimer's disease. (Shiota *et al.*, 2013) finally according to study animal and human independently supports an interdependent relationship between obstructive sleep apnea and Alzheimer's diseases and a deleterious effect of OSA in cognition, (Gao *et al.*, 2013) especially on executive function and attention, may contribute to increasing the level of Alzheimer's diseases. (Ancoli-Israel *et al.*, 1991), (Yaffe *et al.*, 2011), (Bubu *et al.*, 2017) OSA can cause endothelial dysfunction which induces hormonal imbalance and hypoxia as a result of cognition. (Krysta *et al.*, 2017)

An important parameter within the investigation process of OSA is the Apnea-Hypopnea Index (AHI), which represents the amount of apneas and hypopneas per hour of sleep. According to the

AHI-values, OSA might be categorized into three degrees of severity: mild, moderate and severe. AHI decreases and approaches normative values (below five), following an appropriate treatment of OSA

Notwithstanding unnecessary drowsiness, patients with OSA additionally experience neuropsychological side effects like attention deficits, anxiety, cognitive impairment, depressive symptoms and other psychological disturbances resulting in social adjustment difficulties. Patients diagnosed with OSA demonstrate a decline during a wide spectrum of cognitive abilities including memory, attention, psychomotor speed, executive, verbal and visual-spatial skills.

The treatment for OSA is (CPAP) continuous positive air passage. (Calik, 2016) factors that increase the vulnerability for the disorder are age, sex, (male) obesity, family history, menopause, craniofacial abnormality.(Lumeng and Chervin, 2008)Positive airway pressure (PAP) therapy is the most common form of treatment for moderate and severe obstructive sleep apnea. To use the PAP system, the patient wears a nasal or full-face mask that delivers pressurized air to the upper airway, preventing the airway from collapsing during sleep. There are variations in how and at what level the pressure is delivered, including continuous, bilevel, and autotitrator systems.

Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Arigaet *et al.*, 2018; Basha, Ganapathy and Venugopalan, 2018; Hannah *et al.*, 2018; Hussainyet *et al.*, 2018; Jeevanandan and Govindaraju, 2018; Kannan and Venugopalan, 2018; Kumar and Antony, 2018; Manohar and Sharma, 2018; Menon *et al.*, 2018; Nandakumar and Nasim, 2018; Nandhini, Babu and Mohanraj, 2018; Ravinthar and Jayalakshmi, 2018; Seppan, Muhammed, Mohanraj, Lakshmanan, Premavathy, Muthu, WungmarongShimray, *et al.*, 2018; Teja, Ramesh and Priya, 2018; Duraisamyet *et al.*, 2019; Gheena and Ezhilarasan, 2019; Hema Shree *et al.*, 2019; Rajakeerthi and Ms, 2019; Rajendran *et al.*, 2019; Sekaret *et al.*, 2019; Sharma *et al.*, 2019; Siddique *et al.*, 2019; Janani, Palanivelu and Sandhya, 2020; Johnson *et al.*, 2020; Jose, Ajitha and Subbaiyan, 2020).

MATERIALS AND METHODS

A set of the questionnaire is prepared which explains and provokes our thought related obstructive sleep apnea with other disease and a various factor which is usually collected for the research. The people that are involved in the study are the only male, who mostly reside in Tamilnadu. The data are collected from about a hundred male and it is a standard randomized sampling method. Inclusion criteria for the survey. The portion who have the ability to read and understand English.

The data were collected in google forms and extracted in an excel sheet and the collected data are analyses using SPSS version 23.0. The type of statistical correlation analysis used was Chi

square test. These are the salient points covered in the questionnaire like the explanation of obstructive sleep apnea(Vignesh, Babu and Mohanraj, 2018) and cognition(Bilyukov *et al.*, 2018) and the relation between OSA and Alzheimer's disease(Andrade *et al.*, 2018) and behavioral changes. (Deldin, Phillips and Thomas, 2006)

RESULTS AND DISCUSSION

The first goal of the research article is to create awareness and knowledge about obstructive sleep apnea associated with memory and cognition. As a result of the survey various questions are answered and it will be explained briefly (Sekar *et al.*, 2019). From Figure 2 we see that about 70% of the male are already aware of the term obstructive sleep apnea and only 30% have no idea on OSA, it is not expected(Seppan, Muhammed, Mohanraj, Lakshmanan, Premavathy, Muthu, Shimray, *et al.*, 2018). According to Figure 3 About three fourth of the male population who have responded to the question have said the obstructive sleep apnea is a sleeping disorder which causes rapid breathing during sleep and one-fourth of the population said no. (Rajagopalan, 2011) Figure 4 shows that there are several causes of Obstructive sleep apnea but when asked to the people, (Mary, Babu and Mohanraj, 2018) about 44% of the population said that the reason for OSA is Excess body weight and decreased oxygen supply in the blood, 24% said that the cause is only excess body weight, 16% of them said that the cause is only decreased oxygen supply in the blood, and finally 16% of them chose none of the above reasons.(Young, Peppard and Gottlieb, 2002),(Ip *et al.*, 2001)(Mounika and Yuvarajbabu, 2015). In the previous article it is concluded that it is a chronic, sleep-related breathing disorder because periodic narrowing and obstruction of the pharyngeal airway during sleep. (Osman *et al.*, 2018)

Our institution is passionate about high quality evidence based research and has excelled in various fields ((Pc, Marimuthu and Devadoss, 2018; Ramesh *et al.*, 2018; VijayashreePriyadharsini, SmilineGirija and Paramasivam, 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019;Ramadurai *et al.*, 2019; Sridharan *et al.*, 2019;VijayashreePriyadharsini, 2019; Chandrasekar *et al.*, 2020; Mathew *et al.*, 2020; R *et al.*, 2020; Samuel, 2021)

From figure 5, according to the male population responded to the survey said that 25% said Central sleep apnea - the brain doesn't send proper signals to the muscles that control your breathing (Ranasinghe, Yuvaraj Babu and Mohanraj, 2018)and 30% of them said obstructive sleep apnea - you can breathe normally because of upper airway obstruction remaining 45% of them don't know the difference.(Young *et al.*, 2002) Figure 6 Shows that About 72% of the respondents said that that Obstructive sleep apnea can cause cognitive decline or impairment and the remaining 28% of them responded OSA does not cause cognitive decline (Kumar, Babu and Mohanraj, 2018) In a previous research, it is concluded that the prevalence of cognitive impairment in OSA patients was found to be 58.3%. There were 35(62.5%) patients with cognitive impairment in the severe OSA group, while the moderate and mild OSA groups had

17(30.4%) and 4 (7.1%) patients respectively(Preethi, Arjun and Ameer, 2019). Figure 7 shows About 66% of the respondents said that Obstructive sleep apnea can cause neurological problems and the remaining 34% of them responded OSA does not cause neurological problems(Yantis and Neatherlin, 2005). The crude prevalence of high-risk OSA was 47.9% in the cerebrovascular center, 44.1% in the movement disorders center, 34% in the brain tumor center, 33% in the epilepsy center, 29.8% in the psychiatry center, and 36.7% overall(Vaughn, 2012). About 64% of the respondents said that Obstructive sleep apnea can cause Alzheimer's diseases and the remaining 36% of them responded that OSA does not cause Alzheimer's diseases(Ravichandran, Yuvraj Babu and Mohanraj, 2018). (Figure 8) According to a study, Prevalence of Obstructive Sleep Apnea in Alzheimer's Disease Patients is 39.1% (Gaeta *et al.*, 2020).

Treatment is one of the most important facts that one should know from the research article so, when asked the males that what do you think the best treatment for obstructive sleep apnea 43% of them chose continuous positive airway pressure (CPAP), 43 % of them chose medication and remaining 14% of them chose to consult a therapist(Tsuda *et al.*, 2016)(Figure 9). When asked How can I improve my sleep apnea without CPAP about 28% of them responded to do lifestyle changes like weight loss and exercise, 29% of them responded to use Fitted mouthpieces that adjust the lower jaw and keep the tongue from blocking the airway and 32% of them to do both remaining 11% does not know.(Broströmet *et al.*, 2010)(Figure 10)

A previous literature based study reported that OSA if left untreated it can cause long-term health consequences including cardiovascular disease, metabolic disorders,cognitiveimpairment,and depression (Wheaton *et al.*, 2012). In figure 11, when asked food that induces the obstructive sleep apnea 26% of them said Fruits and vegetables 8% of them said Low-fat dairy products, 18% of them said Plant-based oils, 6% of them said Whole grains 42% of them said that all of the mentioned products are inducive(Umakanth, Babu and Mohanraj, 2018), the life expectancy of someone with Obstructive sleep apnea is 8-18 years and most of them had chosen that.(Stålkranztet *et al.*, 2012) Various studies have shown individuals under fifty years of age with OSA to have a life expectancy that is reduced by 8 to 18 years. (Stålkranztet *et al.*, 2012)(Figure 12)Limitations of our survey include a small sample population.(Pranati, Babu and Ganesh, 2017; Shahzan, Babu and Mohanraj, 2018; Johnson *et al.*, 2020) Result we obtained is based on online survey responses given by participants. Due to several issues general consideration and suggestions of participants was not recorded. Doing surveys with a large population (including different age group people as participants) can give more insight into errors.(Affshana and Others, 2015) So in future this survey can be done in small age group people with large numbers of sample population.(Rithanya, Babu and Mohanraj, 2018; Muthukumar and Mohanraj, 2019)

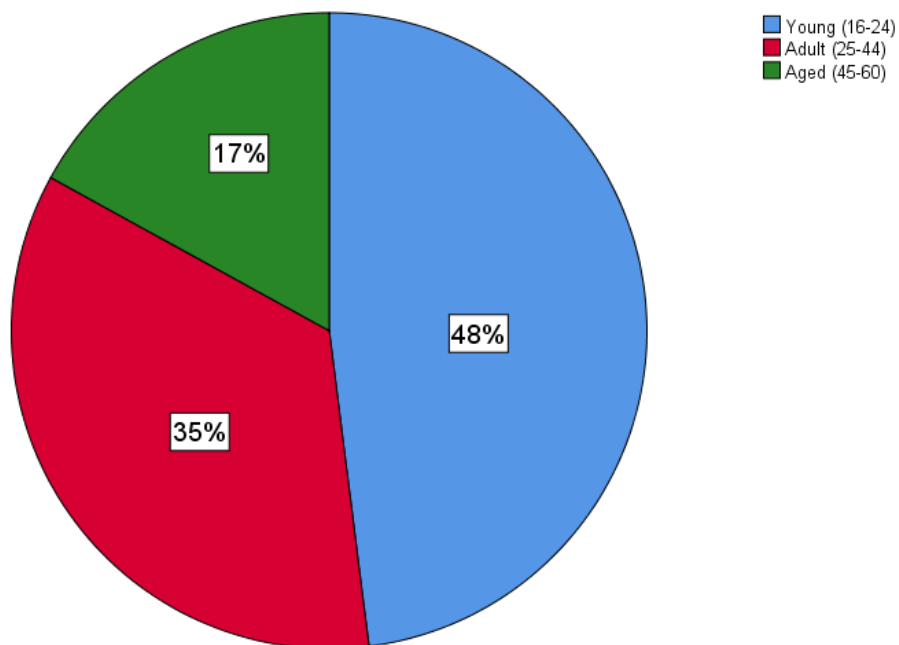


Figure 1: The pie chart shows the percentage of responses according to their age groups 48%(blue) of them are young (16-24 years) 35% (red) of them are Adult (25-44 years) 17% (green) of them are Aged (45-60 years)

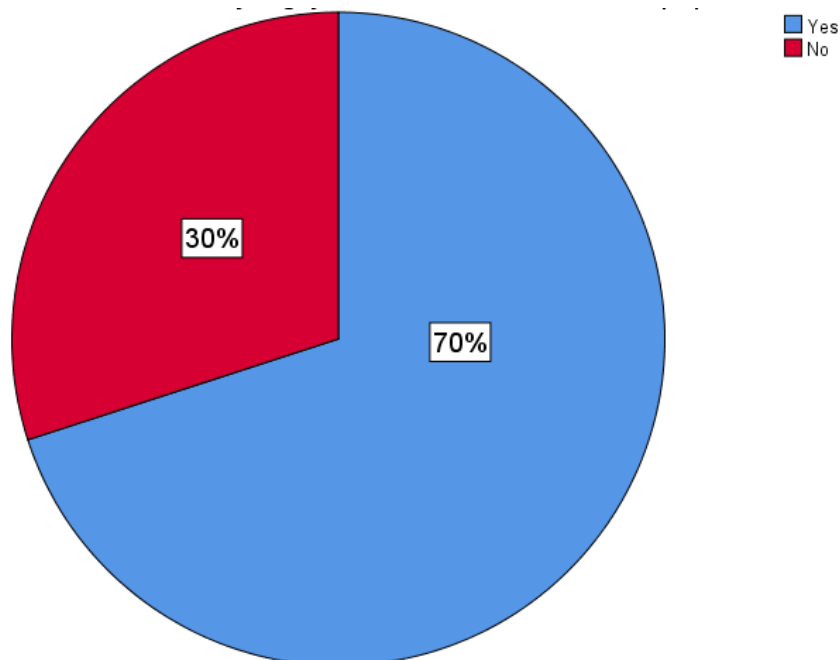


Figure 2: The pie chart shows the percentage of responses given by participants of about awareness of QSA about 70% (Blue) of the male are aware of the term obstructive sleep apnea and only 30%(red) have no idea on OSA

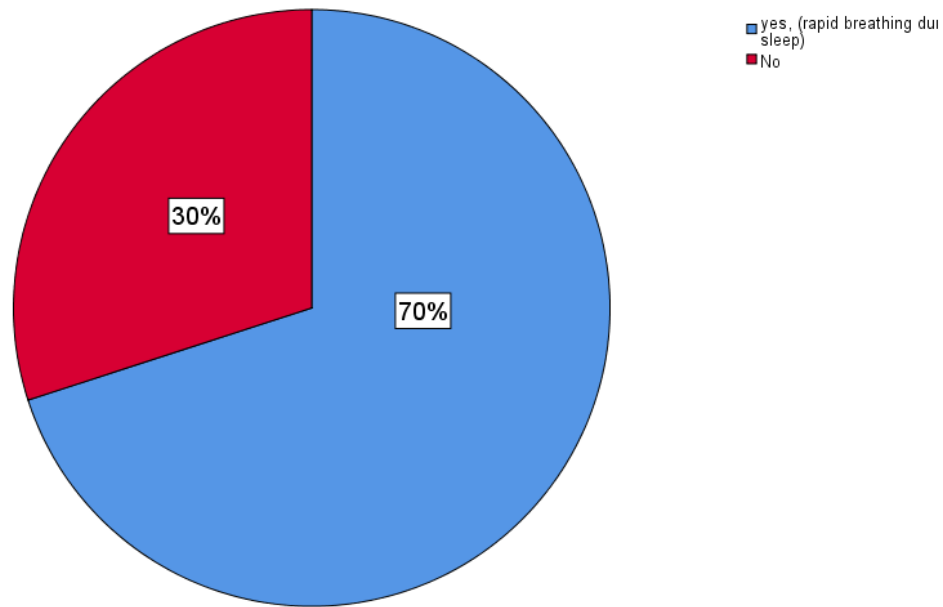


Figure 3: The pie chart shows the percentage of responses given by participants asking OSA is a Sleeping Disorder 70%(Blue) said the obstructive sleep apnea is a sleeping disorder and 30%(red) of them said that they don't know

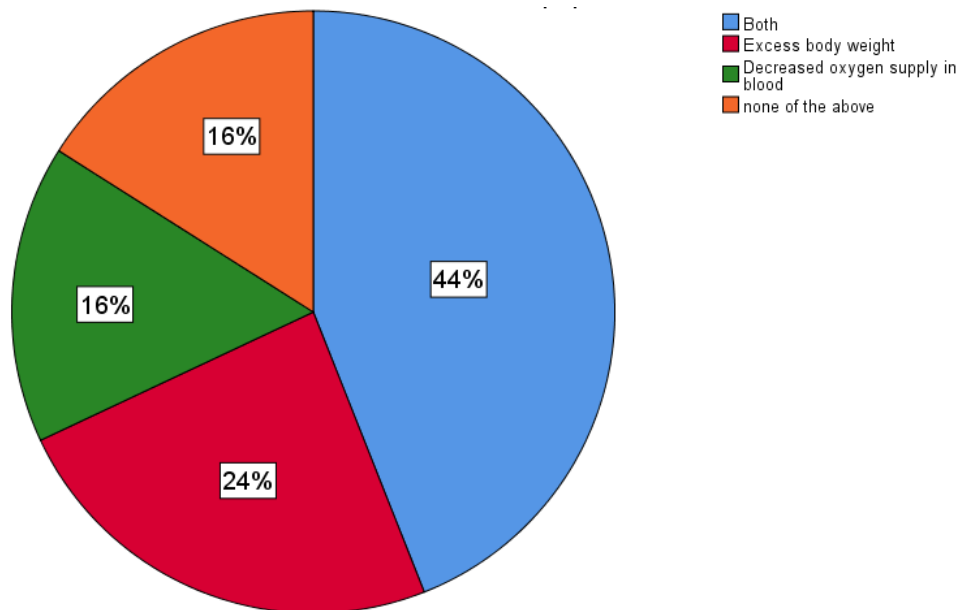


Figure 4: The pie chart shows the percentage of responses given by participants about the causes of OSA 44%(blue) of them said Excess body weight and decreased oxygen supply in the blood, 24%(red) said that the cause is only excess body weight, 16%(green) of them said that the cause is only decreased oxygen supply in the blood, 16%(orange) of them chose none of the above reasons.

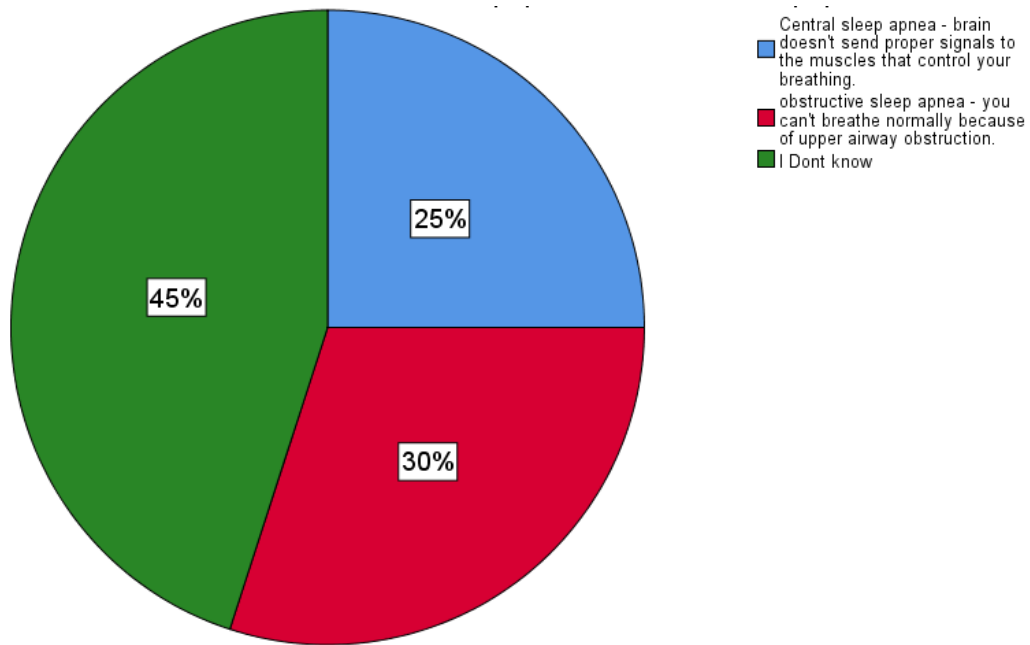


Figure 5: The pie chart shows the percentage of responses given by participants about the difference between CSA and OSA 25%(blue) said Central sleep apnea - the brain doesn't send proper signals to the muscles that control your breathing (Ranasinghe, Yuvaraj Babu and Mohanraj, 2018)and 30%(red) of them said obstructive sleep apnea - you can breathe normally because of upper airway obstruction remaining 45%(green) of them don't know the difference.(Young *et al.*, 2002)

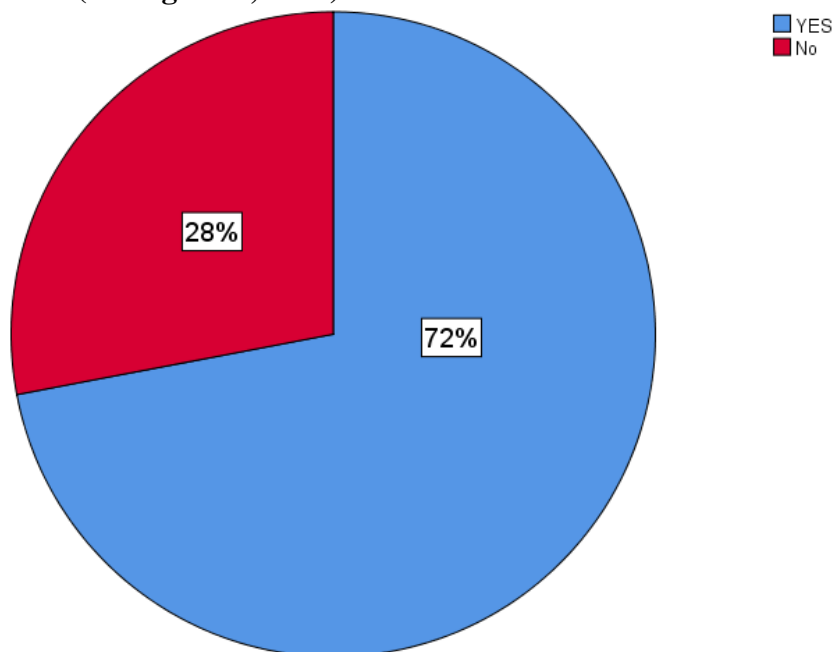


Figure 6: The pie chart shows the percentage of responses given by participants about cause cognitive decline About 72%(blue) of them said Yes 28%(red) of them said No

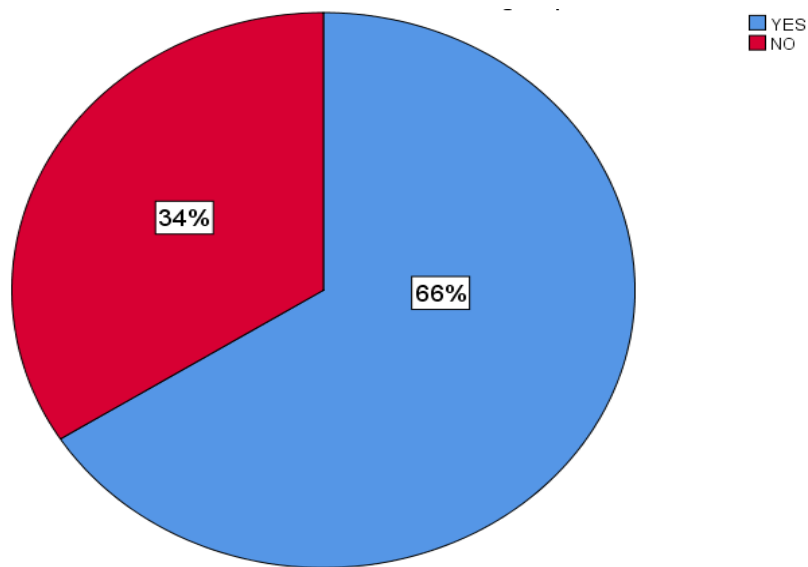


Figure 7:The pie chart shows the percentage of responses given by participants about cause of neurological problems About 66%(blue) said that that Obstructive sleep apnea can cause neurological problems and the remaining 34%(red) of them responded OSA does not cause neurological problems.(Yantis and Neatherlin, 2005)

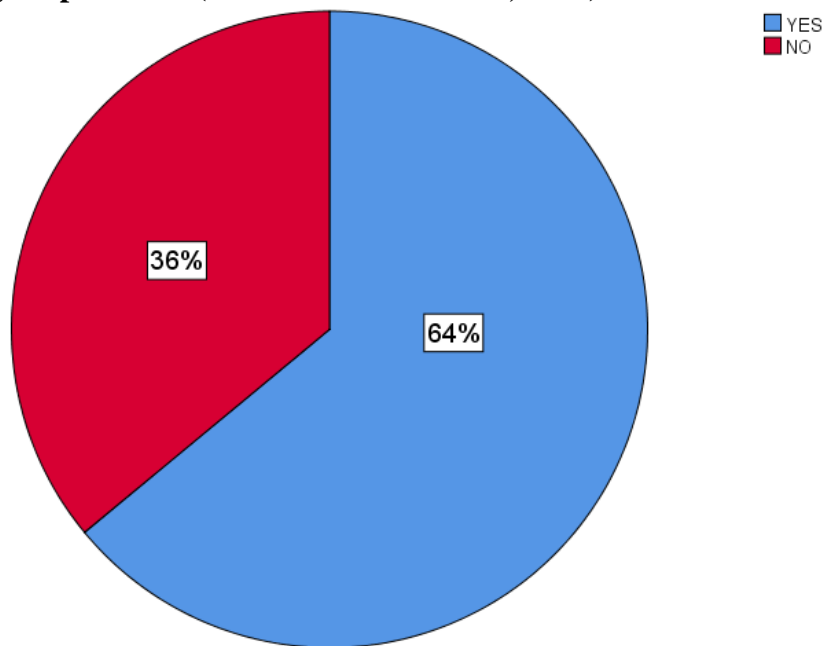


Figure 8: The pie chart shows the percentage of responses given by participants about cause of Alzheimer's disease About 64%(blue) of the respondents said that that Obstructive sleep apnea can cause Alzheimer's diseases and the remaining 36%(red) of them responded OSA does not cause Alzheimer's diseases

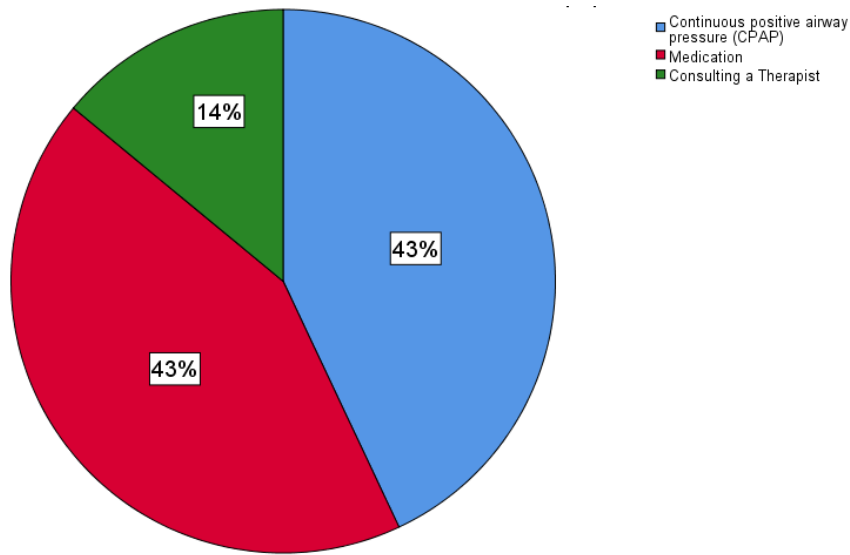


Figure 9: The pie chart shows the percentage of responses given by participants about treatment for obstructive sleep apnea 43%(blue) of them chose continuous positive airway pressure (CPAP), 43 %(red) of them chose medication and remaining 14%(green) of them chose to consult a therapist.(Tsuda *et al.*, 2016)

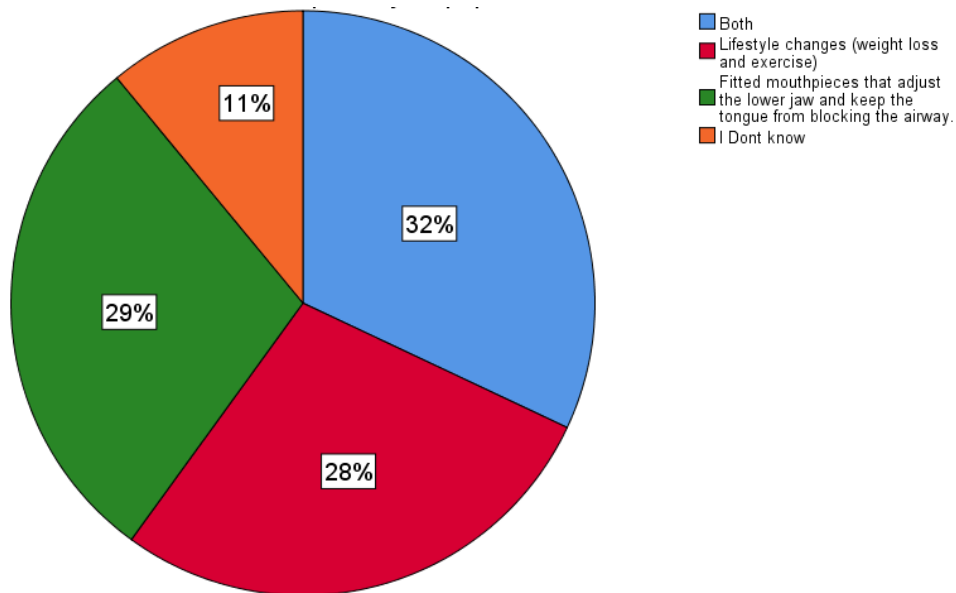


Figure 10:The pie chart shows they percentage of responses given by participants to improve sleep apnea without about 28%(red) of them responded to do lifestyle changes like weight loss and exercise,29%(green) of them responded to use Fitted mouthpieces that adjust the lower jaw and keep the tongue from blocking the airway and 32%(blue) of them to do both remaining 11%(orange) does not know.

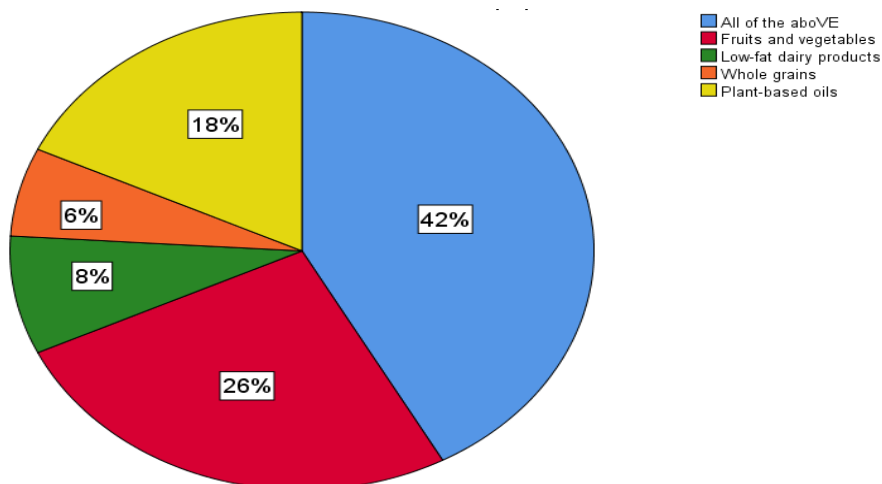
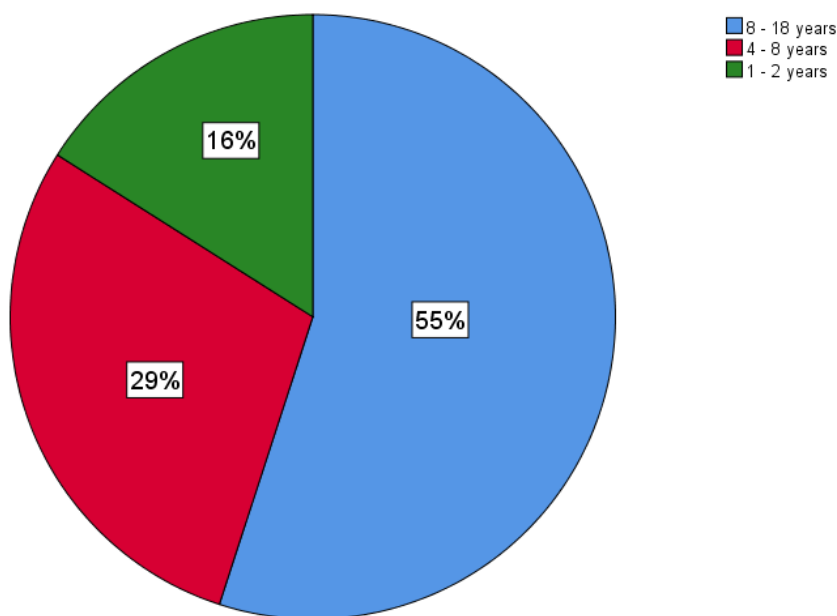


Figure 11: The pie chart shows the percentage of responses given by participants about food induced OSA 26%(red) of them said Fruits and vegetables 8%(green) of them said Low-fat dairy products, 18%(yellow) of them said Plant-based oils, 6%(orange) of them said Whole grains 42%(blue) of them said that all of the mentioned products are inducive.(Umakanth, Babu and Mohanraj, 2018)



In Figure 12:The pie chart shows the percentage of responses given by participants about life expectancy About 55%(blue) of them said 8-18 years, 29%(red) of them said 4-8 years and 16%(green) of them said 1-2 years.According to the responses collected from the survey, Awareness and knowledge are given and most of them are already aware of the obstructive sleep apnea and know the fact earlier itself.

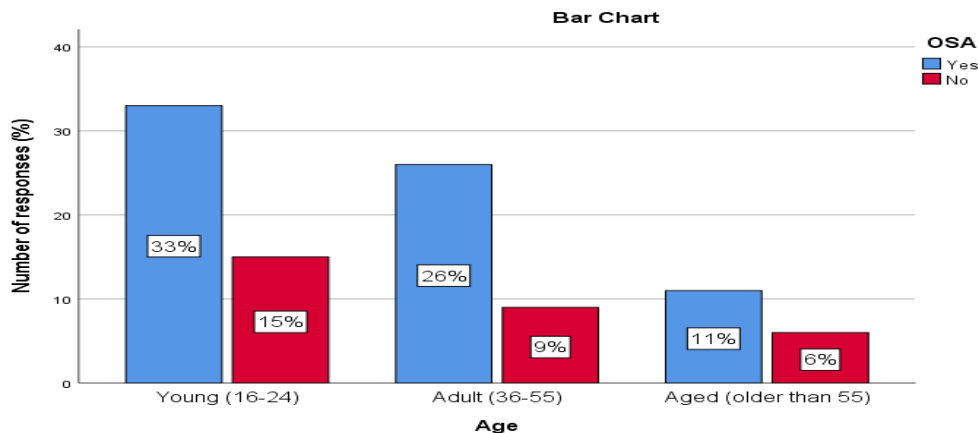


Figure 13: Bar graph showing the association between age and awareness of Obstructive sleep apnea among male population. X axis represents the age groups of the participated male population and the Y axis represents the number of responses. Blue represents that they are aware and red represents that they are not aware. It shows that most of the males of young age (16-24) are aware of OSA; followed by adults (25-44); and then aged (45-60) people. This indicates that younger males are more aware about the obstructive sleep apnea than adults and the aged male population but was not statistically significant. Pearson's Chi square value=0.569, p=0.752 (p>0.05) indicating statistically not significant.

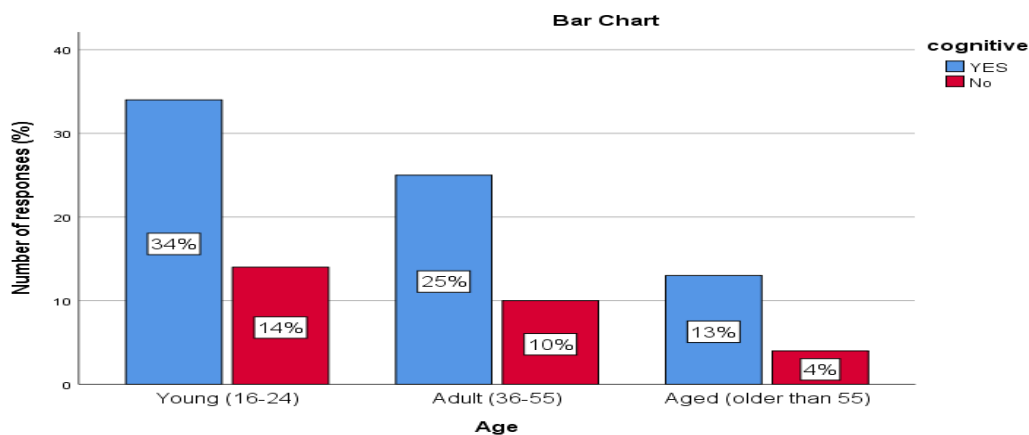


Figure 14: Bar graph shows the association between Age and Cognitive decline. X axis represents the age groups of the responded male population and Y axis represents the number of responses. Blue represents that OSA causes Cognitive decline and red represents that it does not cause cognitive decline. It shows that most of the males of young age (16-24) responded that OSA causes Cognitive decline; followed by adults (25-44); and then followed by aged (45-60) people. This indicates that younger males are more aware about the OSA causing Cognitive decline than adults and the aged male population but was not statistically significant. Pearson's Chi square value- 0.207, p value= 0.902 (p>0.05) hence statistically not significant.

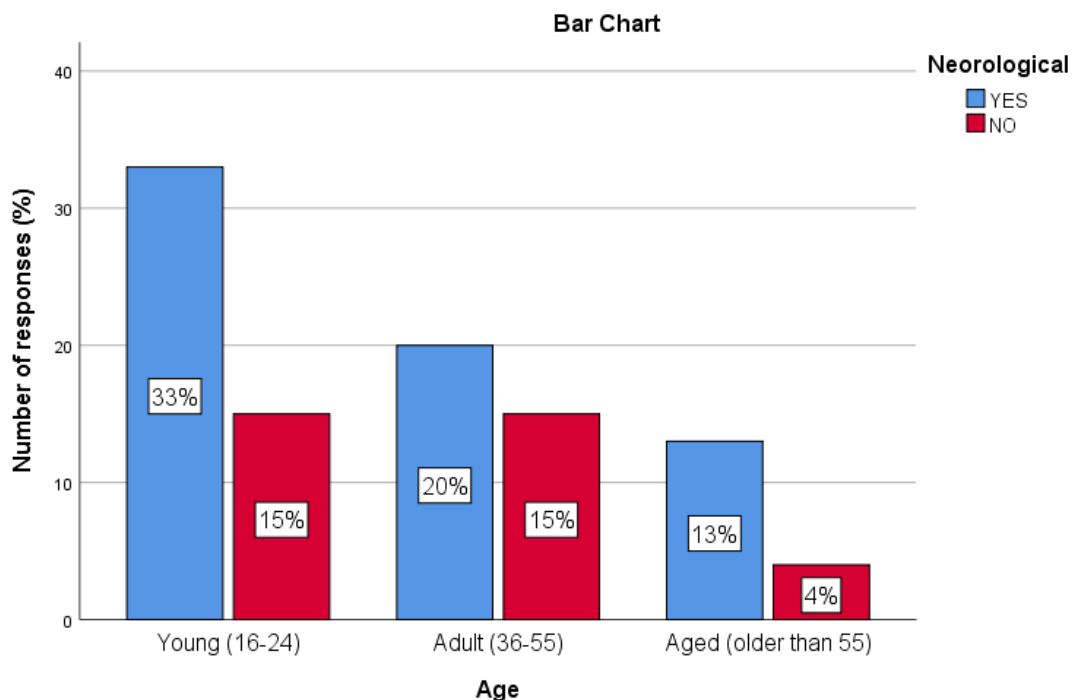


Figure 15: Bar graph shows the association between Age and Neurological problems. The X axis represents the age groups of the responded male population and the Y axis represents the number of responses. Blue represents that OSA causes Neurological problems and red represents that it does not cause Neurological problems. It shows that most of the males of young age (16-24) responded that OSA causes neurological problems; followed by adults (25-44); and then followed by aged (45-60) people. This indicates that younger males are more aware about the OSA causing Neurological problems than adults and the aged male population but was not statistically significant. Pearsons's Chi square value- 2.216, p value= 0.330 ($p > 0.05$) hence statistically not significant.

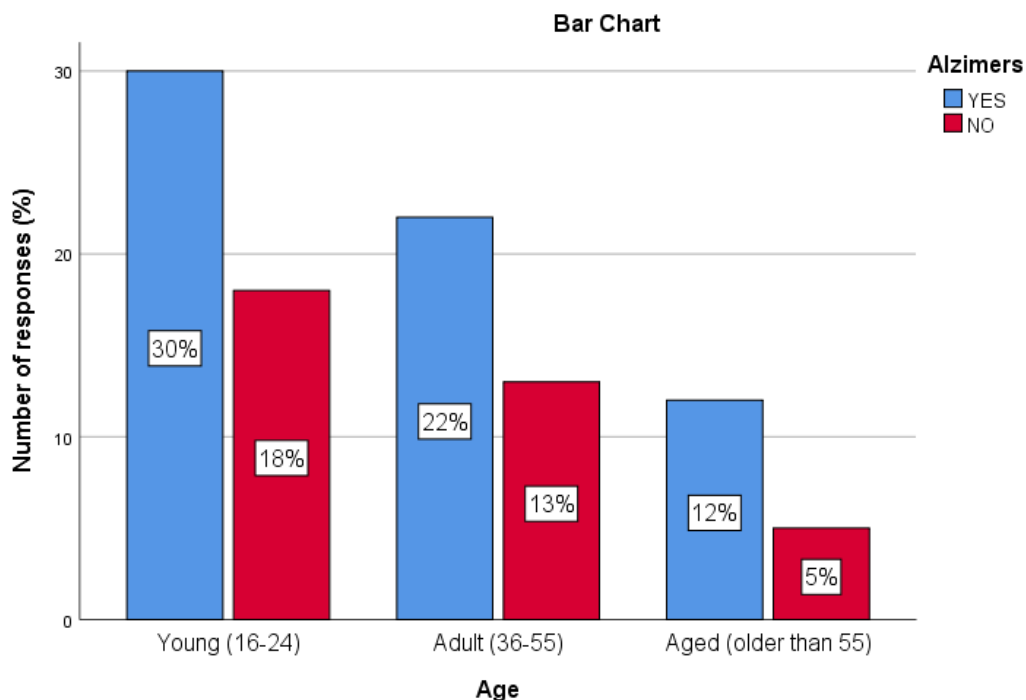


Figure 16: Graph shows the association between Age and whether it causes Alzheimer's disease. X axis represents the age groups of the responded male population and Y axis represents the number of responses. Blue represents that OSA causes Alzheimer's disease and red represents that it does not cause Alzheimer's disease. It shows that most of the males of young age (16-24) responded that OSA causes Alzheimer's disease; followed by adults (25-44); and then followed by aged (45-60) people. This indicates that younger males are more aware about the OSA causing Alzheimer's diseases than adults and the aged male population but was not statistically significant. Pearson's Chi square value- 0.387, p value= 0.824 ($p > 0.05$) hence not significant.

Conclusion

The main purpose of the study is to create awareness and knowledge about obstructive sleep apnea and their causes among male population of different age groups as it is more common in males than in females. From the responses we can conclude that most of the young males are more aware about OSA but not much aware about its consequences on health and day to day life activities. Also OSA on a long term basis if left untreated can cause cognitive decline, related neurological problems and Alzheimer's diseases. So considering the growing interest about obstructive sleep apnea make people conscious and have a lesser chance of causing various diseases. Thus we conclude that the study created an awareness of OSA and the complications caused by it, especially on memory and cognition among the targeted population.

Reference

1. Affshana, M. M. and Others (2015) 'Analysis of the Occipital Condyl', *Research journal of pharmaceutical, biological and chemical sciences*, 7(7), p. 439.
2. Ancoli-Israel, S. *et al.* (1991) 'Dementia in Institutionalized Elderly: Relation to Sleep Apnea', *Journal of the American Geriatrics Society*, pp. 258–263. doi: 10.1111/j.1532-5415.1991.tb01647.x.
3. Andrade, A. G. *et al.* (2018) 'The Relationship between Obstructive Sleep Apnea and Alzheimer's Disease', *Journal of Alzheimer's Disease*, pp. S255–S270. doi: 10.3233/jad-179936.
4. Andrews, J. G. and Oei, T. P. S. (2004) 'The roles of depression and anxiety in the understanding and treatment of Obstructive Sleep Apnea Syndrome', *Clinical psychology review*, 24(8), pp. 1031–1049.
5. Ariga, P. *et al.* (2018) 'Determination of correlation of width of Maxillary Anterior Teeth using Extraoral and Intraoral Factors in Indian Population: A systematic review', *World journal of dentistry*, 9(1), pp. 68–75.
6. Basha, F. Y. S., Ganapathy, D. and Venugopalan, S. (2018) 'Oral hygiene status among pregnant women', *Journal of advanced pharmaceutical technology & research*, 11(7), p. 3099.
7. Bilyukov, R. G. *et al.* (2018) 'Cognitive Impairment and Affective Disorders in Patients With Obstructive Sleep Apnea Syndrome', *Frontiers in psychiatry / Frontiers Research Foundation*, 9, p. 357.
8. Broström, A. *et al.* (2010) 'The side-effects to CPAP treatment inventory: the development and initial validation of a new tool for the measurement of side-effects to CPAP treatment', *Journal of sleep research*, 19(4), pp. 603–611.
9. Bubu, O. M. *et al.* (2017) 'Sleep, Cognitive impairment, and Alzheimer's disease: A Systematic Review and Meta-Analysis', *Sleep*, 40(1). doi: 10.1093/sleep/zsw032.
10. Calik, M. W. (2016) 'Treatments for Obstructive Sleep Apnea', *Journal of clinical outcomes management: JCOM*, 23(4), pp. 181–192.
11. Chandrasekar, R. *et al.* (2020) 'Development and validation of a formula for objective assessment of cervical vertebral bone age', *Progress in orthodontics*, 21(1), p. 38.
12. Deldin, P. J., Phillips, L. K. and Thomas, R. J. (2006) 'A preliminary study of sleep-disordered breathing in major depressive disorder', *Sleep medicine*, 7(2), pp. 131–139.
13. Duraisamy, R. *et al.* (2019) 'Compatibility of Nonoriginal Abutments With Implants: Evaluation of Microgap at the Implant-Abutment Interface, With Original and Nonoriginal Abutments', *Implant dentistry*, 28(3), pp. 289–295.
14. Emamian, F. *et al.* (2016) 'The Association Between Obstructive Sleep Apnea and Alzheimer's Disease: A Meta-Analysis Perspective', *Frontiers in aging neuroscience*, 8, p. 78.
15. Ephros, H. D., Madani, M. and Yalamanchili, S. C. (2010) 'Surgical treatment of snoring & obstructive sleep apnoea', *The Indian journal of medical research*, 131, pp. 267–276.
16. Ezhilarasan, D., Apoorva, V. S. and Ashok Vardhan, N. (2019) 'Syzygiumcumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells', *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(2), pp. 115–121.
17. Farley, J. *et al.* (2006) *Java Enterprise in a Nutshell*. 'O'Reilly Media, Inc.'

18. Gaeta, A. M. *et al.* (2020) 'Prevalence of obstructive sleep apnea in Alzheimer's disease patients', *Journal of Neurology*, pp. 1012–1022. doi: 10.1007/s00415-019-09668-4.
19. Gao, L. *et al.* (2013) 'Hypoxia increases A β -induced tau phosphorylation by calpain and promotes behavioral consequences in AD transgenic mice', *Journal of molecular neuroscience: MN*, 51(1), pp. 138–147.
20. Gheena, S. and Ezhilarasan, D. (2019) 'Syringic acid triggers reactive oxygen species-mediated cytotoxicity in HepG2 cells', *Human & experimental toxicology*, 38(6), pp. 694–702.
21. Hannah, R. *et al.* (2018) 'Awareness about the use, ethics and scope of dental photography among undergraduate dental students dentist behind the lens', *Journal of advanced pharmaceutical technology & research*, 11(3), p. 1012.
22. Hema Shree, K. *et al.* (2019) 'Saliva as a Diagnostic Tool in Oral Squamous Cell Carcinoma - a Systematic Review with Meta Analysis', *Pathology oncology research: POR*, 25(2), pp. 447–453.
23. Hussainy, S. N. *et al.* (2018) 'Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up', *Journal of conservative dentistry: JCD*, 21(5), pp. 510–515.
24. Ip, M. S. M. *et al.* (2001) 'Prevalence of sleep disordered breathing in middle-aged Chinese women in Hong Kong', *American journal of respiratory and critical care medicine*.
25. Janani, K., Palanivelu, A. and Sandhya, R. (2020) 'Diagnostic accuracy of dental pulse oximeter with customized sensor holder, thermal test and electric pulp test for the evaluation of pulp vitality: an in vivo study', *Brazilian dental science*, 23(1). doi: 10.14295/bds.2020.v23i1.1805.
26. Jeevanandan, G. and Govindaraju, L. (2018) 'Clinical comparison of Kedo-S paediatric rotary files vs manual instrumentation for root canal preparation in primary molars: a double blinded randomised clinical trial', *European archives of paediatric dentistry: official journal of the European Academy of Paediatric Dentistry*, 19(4), pp. 273–278.
27. Johnson, J. *et al.* (2020) 'Computational identification of MiRNA-7110 from pulmonary arterial hypertension (PAH) ESTs: a new microRNA that links diabetes and PAH', *Hypertension research: official journal of the Japanese Society of Hypertension*, 43(4), pp. 360–362.
28. Jose, J., Ajitha and Subbaiyan, H. (2020) 'Different treatment modalities followed by dental practitioners for Ellis class 2 fracture – A questionnaire-based survey', *The open dentistry journal*, 14(1), pp. 59–65.
29. Kannan, A. and Venugopalan, S. (2018) 'A systematic review on the effect of use of impregnated retraction cords on gingiva', *Journal of advanced pharmaceutical technology & research*, 11(5), p. 2121.
30. Krysta, K. *et al.* (2017) 'Cognitive deficits in adults with obstructive sleep apnea compared to children and adolescents', *Journal of Neural Transmission*, pp. 187–201. doi: 10.1007/s00702-015-1501-6.
31. Kumar, D. and Antony, S. D. P. (2018) 'Calcified canal and negotiation-A review', *Journal of advanced pharmaceutical technology & research*, 11(8), p. 3727.
32. Kumar, M., Babu, K. Y. and Mohanraj, K. G. (2018) 'Hair fall due to stress factors-A survey', *Drug Invention Today*, 10. Available at:

- <http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09757619&AN=133535074&h=J%2Fui0tB3j%2Fw9PVPpDp5fR5EjZVdaQrAWi%2Be6PGjPNwWCqQIDRoEMFkvVFJyTCf9nRWVQWSgJTCdCJzAjQ4sLWw%3D%3D&crl=c>.
33. Lumeng, J. C. and Chervin, R. D. (2008) 'Epidemiology of Pediatric Obstructive Sleep Apnea', *Proceedings of the American Thoracic Society*, pp. 242–252. doi: 10.1513/pats.200708-135mg.
 34. Manohar, M. P. and Sharma, S. (2018) 'A survey of the knowledge, attitude, and awareness about the principal choice of intracanal medicaments among the general dental practitioners and nonendodontic specialists', *Indian journal of dental research: official publication of Indian Society for Dental Research*, 29(6), pp. 716–720.
 35. Mary, D. A. F., Babu, K. Y. and Mohanraj, K. G. (2018) 'Cranio-metric analysis of foramen magnum with reference to occipital condyles for the determination of sex using dry human skulls', *Drug Invention Today*, 10(10), pp. 1910–1913.
 36. Mathew, M. G. *et al.* (2020) 'Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: Randomized controlled trial', *Clinical oral investigations*, pp. 1–6.
 37. Menon, S. *et al.* (2018) 'Selenium nanoparticles: A potent chemotherapeutic agent and an elucidation of its mechanism', *Colloids and surfaces. B, Biointerfaces*, 170, pp. 280–292.
 38. Mounika, S. and Yuvarajbabu, K. (2015) 'Estimation of stature from the facial width', *Research journal of pharmaceutical, biological and chemical sciences*, 7(6), p. 353.
 39. Muthukumar, A. and Mohanraj, K. G. (2019) 'Prevalence, knowledge, and awareness of thyroid disorders among young adult women population', *Drug Invention Today*, 11(10). Available at: <http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09757619&AN=139166469&h=08%2FIQH5IAJqButG0bj4XefrLVggLB LQDcKueLVUmwSZAfB1OzF1wzTL8teDsCITySWPP7RvXfipmTjwej4hGSQ%3D%3D&crl=c>.
 40. Nandakumar, M. and Nasim, I. (2018) 'Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis', *Journal of conservative dentistry: JCD*, 21(5), pp. 516–520.
 41. Nandhini, J. S. T., Babu, K. Y. and Mohanraj, K. G. (2018) 'Size, shape, prominence and localization of gerdy's tubercle in dry human tibial bones', *Journal of advanced pharmaceutical technology & research*, 11(8), p. 3604.
 42. Osman, A. M. *et al.* (2018) 'Obstructive sleep apnea: current perspectives', *Nature and science of sleep*, 10, pp. 21–34.
 43. Pc, J., Marimuthu, T. and Devadoss, P. (2018) 'Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study', *Clinical implant dentistry and related research*. Available at: <https://europemc.org/article/med/29624863>.
 44. Pranati, T., Babu, K. Y. and Ganesh, K. (2017) 'Assessment of plantar arch index and prevalence of flat feet among south Indian adolescent population', *Research journal of pharmaceutical, biological and chemical sciences*, 9(4), p. 490.
 45. Preethi, V., Arjun, P. and Ameer, K. A. (2019) 'PREVALENCE OF COGNITIVE IMPAIRMENT IN OSA AND ITS ASSOCIATION WITH THE SEVERITY OF OSA:

- A CROSS SECTIONAL STUDY', *Chest*, p. 304A. doi: 10.1016/j.chest.2019.02.295.
46. Rajagopalan, N. (2011) 'Obstructive sleep apnea: not just a sleep disorder', *Journal of postgraduate medicine*, 57(2), pp. 168–175.
 47. Rajakeerthi and Ms, N. (2019) 'Natural Product as the Storage medium for an avulsed tooth – A Systematic Review', *Cumhuriyet Üniversitesi Diş Hekimliği Fakültesi Dergisi*, 22(2), pp. 249–256.
 48. Rajendran, R. *et al.* (2019) 'Comparative evaluation of remineralizing potential of a paste containing bioactive glass and a topical cream containing casein phosphopeptide-amorphous calcium phosphate: An in vitro study', *Pesquisabrasileira em Odontopediatria e Clínica Integrada*, 19(1), pp. 1–10.
 49. Ramadurai, N. *et al.* (2019) 'Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial', *Clinical oral investigations*, 23(9), pp. 3543–3550.
 50. Ramesh, A. *et al.* (2018) 'Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients - A case-control study', *Journal of periodontology*, 89(10), pp. 1241–1248.
 51. Jahan, I., Begum, M., Akhter, S., Islam, Z., Haque, M., Jahan, N. Effects of alternate nostril breathing exercise on cardiac functions in healthy young adults leading a stressful lifestyle, 2020) *Journal of Population Therapeutics and Clinical Pharmacology*, 27 (2), pp. e68-e77.
 52. Ravichandran, S., Yuvraj Babu, K. and Mohanraj, K. G. (2018) 'Correlation of facial and nasal index in gender determination', *Drug Invention Today*, 10(12). Available at: <http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09757619&AN=132447052&h=JXEJ2meSJWc7013i4VT%2Fe%2F1kT4aEq%2BNzJcLFU1fO4RxntcWzIpbexHlpKPrJYc5NRpdUnGu1Ae2sYAF1mdXBiA%3D%3D&crl=c>.
 53. Ravinthar, K. and Jayalakshmi (2018) 'Recent advancements in laminates and veneers in dentistry', *Journal of advanced pharmaceutical technology & research*, 11(2), p. 785.
 54. R, H. *et al.* (2020) 'CYP2 C9 polymorphism among patients with oral squamous cell carcinoma and its role in altering the metabolism of benzo[a]pyrene', *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, pp. 306–312. doi: 10.1016/j.oooo.2020.06.021.
 55. Rithanya, P., Babu, K. Y. and Mohanraj, K. G. (2018) 'Assessment of flat foot by plantar arch index using footprint in aged population', *Drug Invention Today*, 10(11). Available at: <http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09757619&AN=132173457&h=W9tVOiVImSkL%2FQGWIDXzCH%2FQxFzFDjZTVICDMkc3cce60I32b8ugldbGxqUHDzcs%2BP5ntHmpw7BSFGBRxBJOC%2Bg%3D%3D&crl=c>.
 56. Samuel, S. R. (2021) 'Can 5-year-olds sensibly self-report the impact of developmental enamel defects on their quality of life?', *International journal of paediatric dentistry / the British Paedodontic Society [and] the International Association of Dentistry for Children*, 31(2), pp. 285–286.
 57. Sekar, D. *et al.* (2019) 'Methylation-dependent circulating microRNA 510 in preeclampsia patients', *Hypertension research: official journal of the Japanese Society of Hypertension*, 42(10), pp. 1647–1648.

58. Seppan, P., Muhammed, I., Mohanraj, K. G., Lakshmanan, G., Premavathy, D., Muthu, S. J., WungmarongShimray, K., *et al.* (2018) 'Therapeutic potential of *Mucuna pruriens* (Linn.) on ageing induced damage in dorsal nerve of the penis and its implication on erectile function: an experimental study using albino rats', *The aging male: the official journal of the International Society for the Study of the Aging Male*, pp. 1–14.
59. Seppan, P., Muhammed, I., Mohanraj, K. G., Lakshmanan, G., Premavathy, D., Muthu, S. J., Shimray, K. W., *et al.* (2018) 'Therapeutic potential of *Mucuna pruriens* (Linn.) on ageing induced damage in dorsal nerve of the penis and its implication on erectile function: an experimental study using albino rats', *The Aging Male*, pp. 1–14. doi: 10.1080/13685538.2018.1439005.
60. Shahzan, M. S., Babu, K. Y. and Mohanraj, K. G. (2018) 'Estimation of stature using clavicle bone', *Drug Invention Today*, 10. Available at: <http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09757619&AN=133535078&h=L682QH4G27%2FeANs1isIR08Tbxyg5nbkL9HGjCPhOWwzhkbzMKxkinoxuKOiyJk1SPBEXfEw843%2FM3TZvp4nXPg%3D%3D&crl=c>.
61. Sharma, P. *et al.* (2019) 'Emerging trends in the novel drug delivery approaches for the treatment of lung cancer', *Chemico-biological interactions*, 309, p. 108720.
62. Shiota, S. *et al.* (2013) 'Chronic Intermittent Hypoxia/Reoxygenation Facilitate Amyloid- β Generation in Mice', *Journal of Alzheimer's Disease*, pp. 325–333. doi: 10.3233/jad-130419.
63. Siddique, R. *et al.* (2019) 'Qualitative and quantitative analysis of precipitate formation following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi', *Journal of conservative dentistry: JCD*, 22(1), pp. 40–47.
64. Sridharan, G. *et al.* (2019) 'Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma', *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(4), pp. 299–306.
65. Stålkranz, A. *et al.* (2012) 'Everyday life for the spouses of patients with untreated OSA syndrome', *Scandinavian Journal of Caring Sciences*, pp. 324–332. doi: 10.1111/j.1471-6712.2011.00937.x.
66. Teja, K. V., Ramesh, S. and Priya, V. (2018) 'Regulation of matrix metalloproteinase-3 gene expression in inflammation: A molecular study', *Journal of conservative dentistry: JCD*, 21(6), pp. 592–596.
67. Tsuda, H. *et al.* (2016) 'Oral health under use of continuous positive airway pressure and interest in alternative therapy in patients with obstructive sleep apnoea: a questionnaire-based survey', *Gerodontology*, 33(3), pp. 416–420.
68. Umakanth, K., Babu, K. Y. and Mohanraj, K. G. (2018) 'Morphological and morphometrical analysis of Chassignac's tubercle in dry human cervical vertebrae', *Drug Invention Today*, 10(10). Available at: <http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09757619&AN=131602171&h=NLiZSXDhrGjF6HmdJKyPK2INwhOjHfule%2Bb4Surq6k6kfelM6J8ZUo43tOLOFH1v9yBeiJJfyHGwT3Dc5PfgA%3D%3D&crl=c>.
69. Vaughn, B. (2012) *Sleep Disorders, An Issue of Neurologic Clinics - E-Book*. Elsevier Health Sciences.

70. Vignesh, P., Babu, K. Y. and Mohanraj, K. G. (2018) 'Morphometric analysis of gonial angle and mandibular ramus measurement as predictors of sex and age in dry human mandibles', *Drug Invention Today*, 10(10). Available at: <http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09757619&AN=131602164&h=Upwljn1Xxq861nBQwxybwZ2v3wOwnIWNrlwrEESHhRIkuHVYUEV4V3lFJdkvsc1QFNyJlyrWwRbugTzjGBsaOA%3D%3D&crl=c>.
71. VijayashreePriyadharsini, J. (2019) 'In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens', *Journal of periodontology*, 90(12), pp. 1441–1448.
72. VijayashreePriyadharsini, J., SmilineGirija, A. S. and Paramasivam, A. (2018) 'In silico analysis of virulence genes in an emerging dental pathogen *A. baumannii* and related species', *Archives of oral biology*, 94, pp. 93–98.
73. Wheaton, A. G. *et al.* (2012) 'Sleep disordered breathing and depression among U.S. adults: National Health and Nutrition Examination Survey, 2005-2008', *Sleep*, 35(4), pp. 461–467.
74. Yaffe, K. *et al.* (2011) 'Sleep-disordered breathing, hypoxia, and risk of mild cognitive impairment and dementia in older women', *JAMA: the journal of the American Medical Association*, 306(6), pp. 613–619.
75. Yaggi, H. K., KlarYaggi, H. and Strohl, K. P. (2010) 'Adult Obstructive Sleep Apnea/Hypopnea Syndrome: Definitions, Risk Factors, and Pathogenesis', *Clinics in Chest Medicine*, pp. 179–186. doi: 10.1016/j.ccm.2010.02.011.
76. Yantis, M. A. and Neatherlin, J. (2005) 'Obstructive sleep apnea in neurological patients', *The Journal of neuroscience nursing: journal of the American Association of Neuroscience Nurses*, 37(3), pp. 150–155.
77. Young, T. *et al.* (2002) 'Predictors of sleep-disordered breathing in community-dwelling adults: the Sleep Heart Health Study', *Archives of internal medicine*, 162(8), pp. 893–900.
78. Young, T., Peppard, P. E. and Gottlieb, D. J. (2002) 'Epidemiology of obstructive sleep apnea: a population health perspective', *American journal of respiratory and critical care medicine*, 165(9), pp. 1217–1239.
79. Young, T., Skatrud, J. and Peppard, P. E. (2004) 'Risk factors for obstructive sleep apnea in adults', *JAMA: the journal of the American Medical Association*, 291(16), pp. 2013–2016.