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PREVALENCE OF PATIENT-REPORTED NASAL AIRWAY OBSTRUCTION IN AN ORTHODONTIC POPULATION

by

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DEDICATION

This thesis is dedicated to my incredible family, to whom I owe everything. To my husband, Harrison, without whom I would be incomplete. He is my best friend and partner in adventure. His unparalleled commitment and encouragement propelled me through this process. To my dad, whose humility, faith, and discipline inspire mine. To my mom, whose composure, love, and example I can only hope to emulate. And to my siblings, my favorite people, who keep me grounded. Finally, to my in-laws, whom I feel lucky to have as family.

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I would like to thank Dr. Mark Hans, Dr. Juan Martin Palomo, and Dr. Manish Valiathan for building one of the best programs in the country. Thank you for believing in me, for giving me opportunities, and for pushing me forward. Thank you for accepting nothing but the best from your residents. I will carry this expectation with me moving forward.

Dr. Palomo deserves additional gratitude for guidance and expertise throughout this process. With your support of my passion for this topic, I believe we can make a difference.

I am also grateful for Dr. Tarek ElShebiny. Your work ethic is truly second-to-none. You inspire me to work efficiently and prioritize.

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Dr. Diana Ponsky also changed my life. Your surgical expertise allowed me to enjoy the benefits of nasal breathing. I am honored to move our professions forward in an interdisciplinary manner with you all.

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PREVALENCE OF PATIENT-REPORTED NASAL AIRWAY OBSTRUCTION IN AN ORTHODONTIC POPULATION

Abstract

by

REBECCA ANN PETTS

Introduction: Our objective was to determine the prevalence of nasal airway obstruction indicated by the NOSE scale in the population seeking orthodontic treatment. A second objective was to determine if there is a significant difference between the prevalence of nasal airway obstruction in a residency program versus a corporate or private practice.

Methods: The sample consisted of 431 patients seeking orthodontic care who completed the NOSE survey between February 2020 and April 2021 at Case Western Reserve University School of Dental Medicine in the Orthodontic Department (CWRU), a private practice (Solon, OH), and a corporate office (Fairlawn, OH).

Results: In this sample, patient-reported nasal airway obstruction as indicated by the NOSE scale was not correlated with age, gender, nor trauma ($p<0.05$). The mean of all NOSE scores was 8.4 ± 14.7 (95% CI: 7.0-9.8), ranging from 0-80 on a scale of 100. 43.9% (95% CI: 39.1%-48.7%) of patients reported at least “mild” nasal airway obstruction. 11.4% (95% CI: 8.6%-14.9%) of patients reported at least “moderate” nasal airway obstruction. 2.6% (95% CI: 1.3-4.5%) of patients reported “severe” nasal airway obstruction. 0.2% (95% CI: 0.0-1.3%) of patients reported “extreme” nasal airway obstruction. The Kruskal-Wallis Test showed no significant difference in NOSE score

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distribution between an orthodontic residency program, a corporate practice, and a private practice.

Conclusions: The results indicate the prevalence of at least mild nasal airway obstruction in orthodontic populations was 43.9% (95% CI: 39.1%-48.7%), representing or slightly exceeding that of the general population. There was no significant difference in NOSE score distribution between an orthodontic residency program, a corporate practice, and a private practice, indicating that the results collected at CWRU are applicable to most clinicians.

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INTRODUCTION

Breathing is vital. “We must, and do, breathe without serious interruption from birth to death (Del Negro, 2018).” Inhaled air delivers oxygen to the lungs to be carried by red blood cells to the organs, and carbon dioxide is released upon exhalation. Humans are able to breathe through both the nose and the mouth. However, the two are not equal.

The benefits of nasal breathing are countless. In addition to filtering, warming, and humidifying inhaled air, nasal breathing contributes to proper craniofacial development and mental health (Speth, 2019). Additionally, upon inhalation, healthy paranasal sinuses produce nitric oxide, a gas with significant bronchodilating, vasodilating, and antimicrobial activity (Lundberg, 2008). Although formulated in the nineteenth century, George Catlin’s observations of nasal-breathing North and South American Indians are true today: “Not only manly beauty is produced, and manly firmness of character expressed, by a habitual compression of the lips and the teeth; but courage, steadiness of the nerves, coolness, and power, are the infallible results (Goldsmith, 1994).”

However, humans do not always breathe through their noses. They are considered “oronasal breathers,” and shift from nasal breathing to mouth breathing upon encountering nasal obstruction or increased resistance. While humans resort to oronasal breathing during exercise, horses and other obligate nasal breathers, such as rabbits and rodents, employ multiple methods of nasal dilation to minimize airflow resistance. Oral airflow is normally prevented. In fact, if nasal breathing is compromised, implications for these animals are severe (Holcombe, 2007).

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Although mouth-breathing humans can survive without nasal breathing, it is not without consequence. Craniofacial developmental characteristics of a mouth-breathing person often include a high-angle mandibular plane, an increased vertical dimension, a narrow and highly-vaulted palate, increased prevalence of posterior crossbite, a retrognathic mandible, increased overjet, and Angle Class II malocclusion (El Aouame, 2016) (D'Ascanio, 2010) (Milanesi, 2018). In fact, Edward Angle regarded mouth breathing as the most potent and constant cause of malocclusion (Angle, 1907)." The term "adenoid facies" has often been used to describe these patterns (Quick, 1978), which are sometimes accompanied by "allergic shiners," or venous pooling under the eyes due to nasal congestion (Berger, 2004).

These findings can be described by the functional matrix theory, which states that a functional matrix, which carries out a function, acts on a related skeletal unit. The skeletal unit responds appropriately to this demand by changing size, shape, or position (Moss, 1969). In the case of nasal obstruction, this may cause disharmony in the growth of orofacial structures (D'Ascanio, 2010).

Finally, mouth breathing results in an overall reduction in quality of life. Specifically, those with nasal obstruction exhibit a higher prevalence of anxiety, depression, and sleep disorders (Ma, 2020) (Lavie, 1987). This literature review was completed in an effort to gain a comprehensive understanding and emphasize the importance of nasal breathing in order to improve patients' qualities of life.

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REVIEW OF THE LITERATURE

Benefits of Nasal Breathing

The benefits of nasal breathing are countless. In addition to filtering, warming, and humidifying inhaled air, nasal breathing contributes to proper craniofacial development and mental health. In 2019, after following patients undergoing medical management for nasal obstruction, Speth and colleagues concluded that improvements in nasal manifestations/symptoms of chronic rhinosinusitis directly translate to significant improvements in mood (Speth, 2019).

Nasal breathing also causes airflow through the paranasal sinuses, which include the maxillary, frontal, ethmoidal and sphenoidal sinuses. In 2008, Lundberg summarized paranasal sinus physiology, citing the discovery of nitric oxide in 1995. Since then, it has been discovered that healthy paranasal sinus epithelium expresses an inducible nitric oxide synthase that continuously generates large amounts of nitric oxide. This gas is a pluripotent messenger with potent bronchodilating, vasodilating, and antimicrobial activity, and can be measured noninvasively in an exhaled nasal breath. When nitric oxide is inhaled, a diluted form reaches the lungs and enhances pulmonary oxygen uptake via local vasodilation. Due to its transportation and regulatory tissue action upon every nasal breath, nitric oxide can be considered an “aerocrine” hormone (Lundberg, 2008).

Nitric oxide also acts as an antimicrobial by directly inhibiting pathogen growth and stimulating mucociliary activity, enhancing the local host defense. In fact, the concentration of nitric oxide in a healthy sinus exceeds those that are needed for antibacterial effects *in vitro*. This concept is further supported by the diagnostically low or

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absent nitric oxide levels in patients with primary ciliary dyskinesia or cystic fibrosis. This defect in nitric oxide production likely contributes to their significant susceptibility to chronic sinusitis. (Lundberg, 2008).

Martel also highlighted the importance of nasal breathing in 2020, when she suggested its potential benefits against COVID-19. Studies indicate that nitric oxide may help reduce respiratory tract infection by inactivating viruses and inhibiting their replication in epithelial cells. Recently, clinical trials have examined the effects of inhaled nitric oxide in patients with COVID-19. Martel's article proposes that lifestyle factors such as mouth breathing may affect the antiviral response against COVID-19 by bypassing nasal filtration and subsequently, reducing normal nitric oxide levels. It has been shown that simple devices that promote nasal breathing during sleep help prevent the common cold. This encouraging evidence may translate to benefits against COVID-19 infection. In the absence of effective treatments against COVID-19, Martel and colleagues proposed alternative strategies for consideration (Martel, 2020).

Consequences of Nasal Airway Obstruction: Damages to Dental and Craniofacial Growth

The detrimental relationship between nasal airway obstruction and dental and craniofacial growth has been extensively documented. Several of these studies will be cited. In 2016, El Aouame and colleagues analyzed lateral cephalograms of mouth-breathers versus controls. Among the mouth-breathers, they noted mandibular retrusion (SNB) in association with posterior rotation and more pronounced tilt of the mandibular plane (PP-MP) compared with the controls, a disproportionate increase in anterior facial height and a decrease in posterior face height (hyperdivergence). In other words, they reported a Class II skeletal relationship, a high-angle mandibular plane, and an increased

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vertical dimension in mouth-breathers. Due to the potential growth differences, collaboration between the pediatric dentist, the orthodontist and the ENT is essential. Early diagnosis of mouth-breathing and appropriate treatment will recreate the best conditions for harmonious development (El Aouame, 2016).

D'Ascanio and colleagues had similar conclusions. They compared the skeletal and dental features of children with chronic nasal airway obstruction due to nasal septal deviation and controls. Those with nasal airway obstruction showed a statistically significant increase of upper anterior facial height (N-palatal plane) and total anterior facial height (N-Me). The angular relationships of the sella-nasion, palatal, and occlusal planes to the mandibular plane were also greater in those with nasal obstruction. Additionally, the gonial angle (Ar-Go-Me), palatal height and overjet were significantly higher in the mouth-breathing group. A significantly retrognathic position of the maxilla and mandible was recorded in those with nasal obstruction. Most mouth-breathing children showed class II malocclusion, while the majority of control subjects presented normal occlusion. The prevalence of cross-bite was also higher in those with nasal obstruction. Finally, maxillary intermolar width was significantly smaller in the mouth-breathing group (D'Ascanio, 2010).

Milanesi led a multidisciplinary study including speech therapy, otorhinolaryngologic, dental and physiotherapy evaluations in which association with mouth breathing diagnosis was found in each discipline. Mouth breathing was associated with: report of nasal obstruction, time of pacifier use, convex facial type, obtuse nasal angle, half-open or open lip posture, tongue position on the mouth floor, reduced hard palate width, unexpected contraction during mastication, obstructive pharyngeal tonsils,

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and Angle Class II malocclusion. They suggested that a multidisciplinary diagnosis is important, given that each profession's responsibility for factors associated with mouth breathing diagnosis (Milanesi, 2018).

The term "adenoid facies" has often been used to describe these patterns in dental and craniofacial growth, which are often accompanied by "allergic shiners," or venous pooling under the eyes due to nasal congestion (Berger, 2004). Quick and Gundlach originally defined adenoid facies in 1978 as a sniffling child with a blank expression, pinched nose and gaping mouth. (Quick, 1978). Sheeba and colleagues further define adenoid facies as the open-mouthed appearance in children, associated with a narrow nose, shortened upper lip, narrow palate, high palatal vault, and dental crowding (Sheeba, 2018). Quick's article noted that after the age of 9 or 10, adenoid hypertrophy is less significant (Quick, 1978). Therefore, it can be inferred that at this age, other contributing factors such as nasal airway obstruction should be considered.

The question remains: *why* does nasal obstruction lead to damages in dental and craniofacial growth? Schlenker and colleagues evaluated 5 dogs who underwent tracheotomies and presented two components of chronic oral respiration that influence facial development. The first is chronic absence of active nasal respiration and the second is chronic mouth opening (Schlenker, 2000). Mouth-breathers must compromise posture to compensate the reduction in nasal airflow (Josell, 1995). Posture changes include a lower position of the mandible and an anterior and lower position of the tongue, usually associated with reduced orofacial muscle tonicity (Valera, 2003). This position affects the balance of the tongue and facial musculature/soft tissues, which influence the development of the skull (Schlenker, 2000). This is an example of Melvin Moss's

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functional matrix theory, which states that a functional matrix, which carries out a function, acts on a related skeletal unit. The skeletal unit responds appropriately to this demand by changing size, shape, or position (Moss, 1969). In the case of nasal obstruction, this may cause disharmony in the growth of orofacial structures (D'Ascanio, 2010).

Consequences of Nasal Airway Obstruction: Anxiety and Depression

Additional consequences of nasal airway obstruction include psychological disorders. Society's recent focus on mental health awareness encouraged studies in this area. Akkoca and colleagues recently found that anxiety levels are elevated in patients with symptoms of nasal obstruction, even when there is lack of organic nasal pathology (Akkoca, 2020).

In 2020, Ma and colleagues used the Zung Self-rating Anxiety/Depression Scale to evaluate the prevalence and severity of anxiety and depression. They found that depression and anxiety are more common and severe in patients with nasal septal deviation. Therefore, psychological distress should be considered during the diagnostic and therapeutic process for patients with nasal obstruction (Ma, 2020).

Consequences of Nasal Airway Obstruction: Sleep and Quality of Life

Obstructive sleep apnea has been extensively studied and has repeatedly shown that nasal breathing plays a major role in the regulation of respiration in sleep. These reports confirm century-old clinical findings on the importance of nasal breathing in sleep. The detrimental effects of mouth breathing have been reported as early as the 16th century. Over the following 500 years, many have shown that obstructed nasal breathing causes sleep disorders (Lavie, 1987).

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In 2016, Thomas and colleagues shared that 82% of patients reporting a NOSE score ≥ 30 reported poor sleep (PSQI ≥ 5). They also concluded that the NOSE sleeping subdomain correlated strongly with the PSQI total score (Thomas, 2016).

In 2015, Shuaib and colleagues studied the severity of obstructive sleep apnea before and after functional rhinoplasty. A 57 percent reduction in apnea-hypopnea index scores was shown after excluding patients with a body mass index greater than 30. Their results showed that functional rhinoplasty can significantly improve the severity of obstructive sleep apnea for select patients with nasal obstruction. They theorized that improvement in nasal airflow modifies pharyngeal aerodynamics. This approach should be considered in patients with obstructive sleep apnea and nasal obstruction, especially in patients with a body mass index less than 30 (Shuaib, 2015).

Kara and colleagues studied sleep quality in those with nasal obstruction, but without obstructive sleep apnea. Compared with the control group, patients with nasal septum deviation were found to be significantly higher in all parameters of the Pittsburgh Sleep Quality Index (Kara, 2016), indicating a poorer quality of sleep.

Often linked to sleep quality is overall quality of life. Meltzer and colleagues assessed quality of life in 312 people with allergic rhinitis symptoms using the SF-36 and Rhinoconjunctivitis Quality of Life Questionnaire. They noted statistically significant reductions in quality of life related to physical, mental, and social functioning, including disrupted sleep pattern, fatigue, and poor concentration (Meltzer, 1997).

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Anatomy and Physiology of the Midface

Familiarity with “normal” anatomy is crucial to understanding and recognizing that which is abnormal. As such, identifying nasal airway obstruction requires an understanding of the anatomy of the nose and surrounding midfacial structures. Von Arks describes this in detail. The nasal cavity is a bilateral structure bordered inferiorly by the hard palate, which is anteriorly formed by the palatine processes of the maxilla and posteriorly by the horizontal plates of the palatine bones. The nasal cavity is bordered superiorly by the cribriform plate of the ethmoid bone, and a midline nasal septum divides the nasal cavity into two. Externally and anteriorly, the nostrils serve as doorways for movement of air into the nasal vestibules, which are positioned outside the osseous part of the nose. The nasal cavities also have posterior openings, called choanae, that communicate with the nasopharynx.

Figure 4. Skeletal Framework of the Nose and Adjacent Structures (von Arx, 2019).

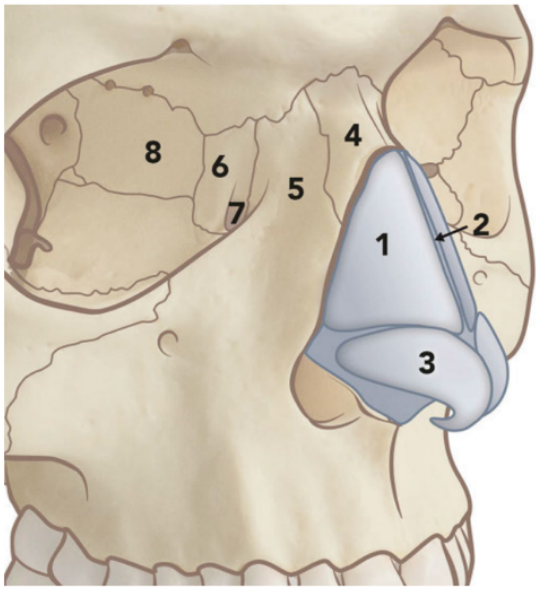


Fig. 1 Graphic illustration of the skeletal framework of the nose and adjacent structures
1 = upper lateral cartilage; 2 = superior margin of septal cartilage; 3 = lower lateral (alar) cartilage; 4 = nasal bone; 5 = frontal process of os maxillae; 6 = lacrimal bone; 7 = cavity for lacrimal sac; 8 = lamina orbitalis (papyracea) of ethmoid bone

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The skeletal framework of the nose is illustrated above, with (1) the upper lateral cartilage, (2) superior margin of septal cartilage, (3) lower lateral (alar) cartilage, (4) nasal bone, and (5) frontal process of maxilla.

Figure 5. Left Nasal Cavity and Adjacent Structures (von Arx, 2019).

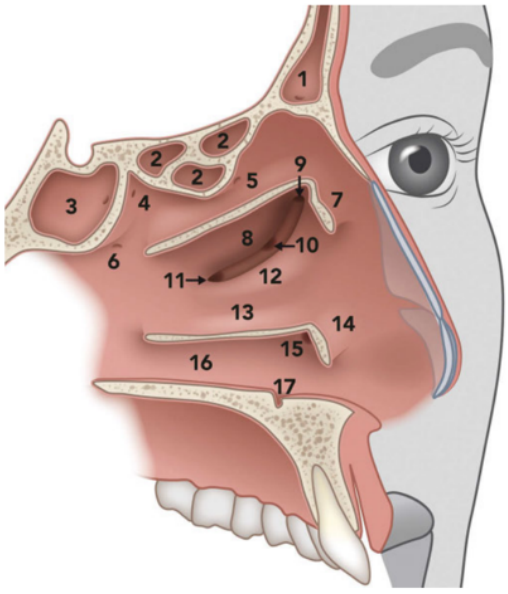


Fig. 3 Graphic illustration of the left nasal cavity and adjacent structures 1 = frontal sinus; 2 = ethmoid cells (ethmoid sinus); 3 = sphenoid sinus; 4 = sphenoethmoidal recess with opening of sphenoid sinus; 5 = upper nasal meatus with opening of posterior ethmoid cells; 6 = location of underlying sphenopalatine foramen; 7 = partially resected middle concha; 8 = bulla ethmoidalis; 9 = opening of frontal sinus in upper part of semilunar hiatus; 10 = opening of anterior ethmoid cells in middle part of semilunar hiatus; 11 = opening of maxillary sinus (ostium maxillare) in lower part of semilunar hiatus; 12 = uncinate process of ethmoid bone; 13 = middle nasal meatus; 14 = partially resected inferior concha; 15 = opening of nasolacrimal duct; 16 = inferior nasal meatus; 17 = nasal opening of nasopalatine canal

The nose has several important functions. Most apparently, it provides a means for proper respiration and olfaction. Vestibular hairs clean inhaled air, while the nasal mucosa warms and humidifies it. The nasal conchae, shown above, provide increased surface area of the functional mucosa. Additionally, the superior conchae, or turbinates, are covered in olfactory epithelium, enhancing sense of smell. The three turbinates (superior, middle, and inferior), derive their name from the Latin word meaning “to disturb.” A cross-section of the turbinates in the coronal plane reveals a scrolled appearance (von Arx, 2019).

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Figure 6. Nasal Septum and Adjacent Structures (von Arx, 2019).

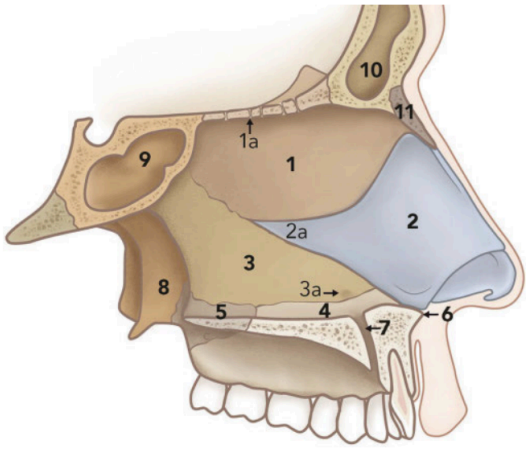


Fig. 13 Graphic illustration of the nasal septum (right side) and adjacent structures
1 = perpendicular plate of ethmoid bone; 1a = cribriform plate of ethmoid bone; 2 = septal cartilage; 2a = posterior (sphenoidal) process of septal cartilage; 3 = vomer; 3a = vomeronasal cavity; 4 = nasal crest of maxillary bone; 5 = nasal crest of palatine bone; 6 = anterior nasal spine; 7 = nasopalatine (incisive) canal; 8 = medial plate of pterygoid process of sphenoid bone; 9 = sphenoid sinus; 10 = frontal sinus; 11 = nasal bone

The nasal septum is both an osseous and cartilaginous structure, shown above. The perpendicular plate of ethmoid bone, vomer, septal cartilage, nasal crest of the maxillary bones, and the nasal crest of the palatine bones each contribute to the septum (Ogle, 2012).

Figure 7. Airway Lumen and Valves (Strohl, 2012).

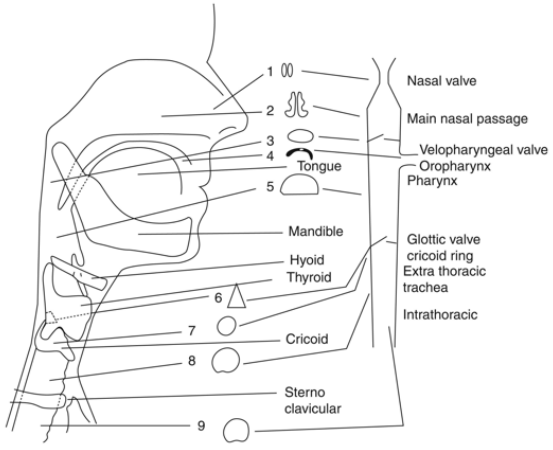


Figure 1.
A drawing in the sagittal plane of the shape changes of the airway lumen and size and the location of valves (nasal, velopharyngeal, and glottic or laryngeal) encountered as air travels from the external nares to the trachea on inspiration or from the lungs in expiration. (Reprinted, with permission, from Proctor ([105])

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Functionally, the upper airway has narrow regions that limit airway caliber, or distensibility. These include the nostrils, the lips, the palate, and the larynx, as depicted and described by Strohl, shown above.

Figure 8. Cross-section View of Internal Nasal Valve (HSU, 2018).

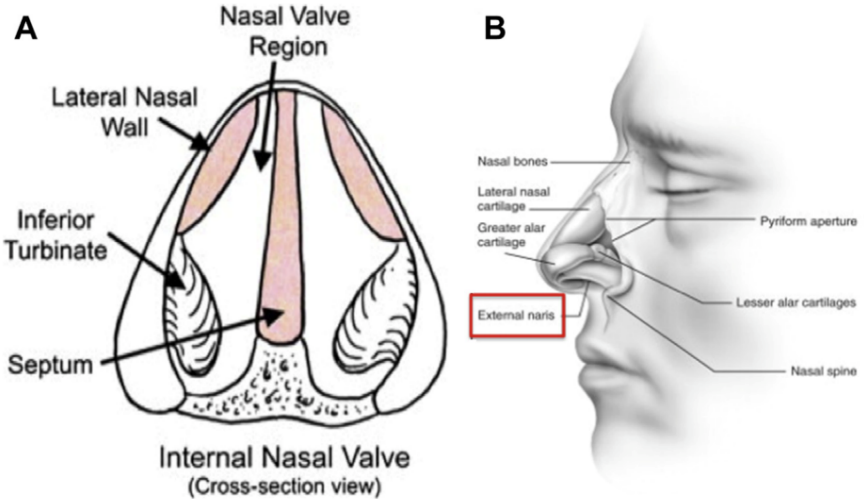


Fig. 4. (*A*) Internal nasal valve. (*B*) External nasal valve. (*From* [*A*] Cannon DE, Rhee JS. Evidence-based practice. Otolaryngol Clin North Am 2012;45(5):1033–43, with permission; and [*B*] Egan KK, Kim D, Kezirian EJ. Nasal obstruction and sleep-disordered breathing. In: Friedman M, editor. Sleep apnea and snoring. China: Elsevier; 2009. p. 120–3; with permission.)

The nasal valve, the airway encompassed by the nostrils shown above, is the first distensible, narrow region air encounters upon inhalation. Therefore, functional patency is crucial to breathing optimally. Covering the surfaces of the airway, mucosa is also essential, as it has capability to influence airway caliber. In fact, in the nose, the submucosal vascular network has characteristics of erectile tissue. Additionally, the pharyngeal wall is highly deformable while the nose, larynx, and trachea are surrounded by a rigid cartilaginous framework (Strohl, 2012).

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Figure 9. Vasculature and Sensory Innervation of the Nose (Hsu, 2018).

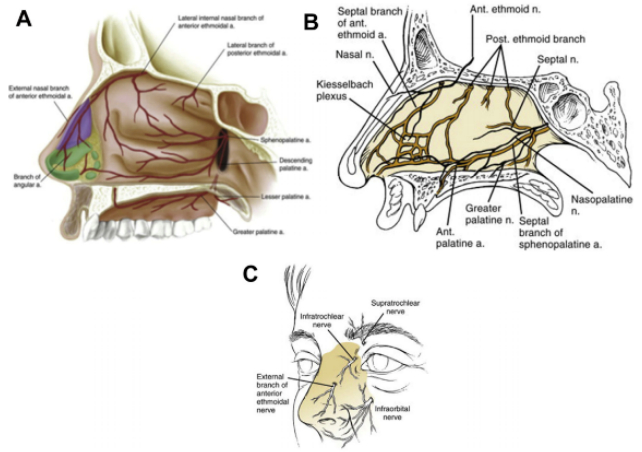


Fig. 5. (*A*) Arterial supply of nasal cavity. (*B*) Vasculature and sensory innervation of internal nasal cavity. Kiesselbach plexus represents the confluences of terminal branches of the external and internal carotid arteries in the nose. (*C*) Sensory innervation of external nose. (*From* [*A*] Baker SR. Reconstruction of the nose. In: Baker SR, editor. Local flaps in facial reconstruction. Philadelphia: Saunder; 2014. p. 415–80, with permission; and [*B*] Kridel R, Sturm-O'brien A. Nasal septum. In: Flint PW, Haughey BH, Lund V, et al, editors. Cummings otolaryngology. Philadelphia: Saunders; 2015. p. 474–92, with permission; and [*C*] Chegar BE, Tatum SA. Nasal fractures. In: Flint PW, Haughey BH, Lund V, et al, editors. Cummings otolaryngology. Philadelphia: Saunders; 2015. p. 493–505, with permission.)

This framework provides a pathway for optimal function. Hsu states that ideal nasal airflow is determined by patent nasal passages, intact mucociliary function, normal functioning receptors for airflow, and degree of mucosal inflammation (Hsu, 2018). Specifically, the turbinates induce non-laminar airflow. Trigeminal cool thermoreceptors sense temperature changes and turbulent airflow, which then regulate the sensation of airflow and nasal patency (Sozansky, 2014). Finally, the autonomic nervous system controls those nasal cavity functions not consciously directed, such as degree of vascular tone, level of congestion, and production of secretions (Kridel, 2015).

Nasal Cycling

Although seemingly similar to pathologic nasal obstruction, the following concept is physiologically normal, and is important to distinguish from the abnormal. Pendolino defines the nasal cycle as "the spontaneous congestion and decongestion of the nasal

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mucosa during the day, where congestion of one side is generally accompanied by reciprocal decongestion of the contralateral side (Pendolino, 2019).” It is accepted that 70% to 80% of adults experience a normal nasal cycle (Hasegawa, 1977). The hypothalamus centrally regulates four types of regular nasal cycle patterns: classic, parallel, irregular, and acyclic. It is important to note that unless a patient is hyperaware, the pattern of nasal cycle does not influence subjective nasal obstruction sensation (Pendolino, 2019). This is because the total nasal resistance usually remains fairly constant and is less than the resistance of either one of the individual nasal passages (Hasegawa, 1977).

Nasal Obstruction: Anatomy and Contributors

In 1997, Jessen defined nasal obstruction as discomfort manifested as a feeling of insufficient airflow through the nose (Jessen, 1997). Among others, anatomic causes include septal deviation, inferior turbinate hypertrophy, and nasal valve collapse (Clark, 2018). The internal nasal valve gives the greatest overall resistance to airflow. According to Bernoulli’s principle, Bernoulli forces favor the collapse of the nasal valve because high velocity airflow causes a decrease in intraluminal pressure and a subsequent vacuum effect. Poiseuille law states that airflow is proportional to the radius of the airway raised to the fourth power. These principles contribute to a decrease in nasal diameter upon inhalation and resistance to airflow. Luckily, although septal deviation and hypertrophic turbinates are common anatomic causes for nasal obstruction, they are easily treatable (Hsu, 2018).

In 2019, Üstün and colleagues analyzed CT scans and reported that the septal deviation rate among patients complaining of nasal obstruction was 85%, internal valve

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insufficiency rate was 34.4%, and mild and severe inferior turbinate hypertrophy was 71% and 6%, respectively. 17.3% of patients had bullous and total concha bullosa of middle turbinate. Most importantly, nearly 90% of patients had 2 or more types of pathology. They also concluded that no singular pathology or treatment had a dominating effect on initial complaints or postoperative relief (Üstün, 2019). Additionally, a study done by Weitzman revealed that, despite unilateral nasal obstruction, patients has symptoms similar to those with bilateral obstruction. (Weitzman, 2020).

Recognition and standardization of nasal obstruction is difficult because technically, it is a subjective complaint. Patients may complain of nasal stuffiness and/or nasal blockage. Some authors have considered the word “obstruction” to imply the existence of a physical obstacle in the nose, suggesting an objective definition. However, symptoms such as nasal congestion and secretions are tolerated very differently among patients, and can be considered nasal obstruction in many cases. Thus, it is difficult to obtain a realistic estimate of how common nasal obstruction is (Jessen, 1997). and Regardless, the patient’s perception of congestion, a perception of reduced airflow or a sense of nasal fullness, is the key consideration in clinical practice (Stewart, 2010).

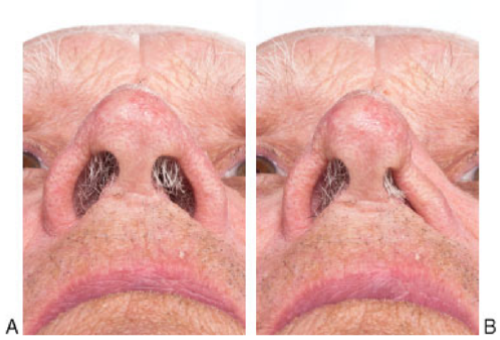
Nasal obstruction can also be manifested as abnormal inflammatory responses, as in rhinitis and sinusitis. Imbalance between the parasympathetic and sympathetic nervous systems may result in increased congestion and resulting obstruction if the parasympathetic system is favored (Hsu, 2018).

The etiology of nasal obstruction is extensive and multifactorial. Nasal obstruction can be caused by a wide array of anatomic, physiologic, pathophysiologic, and iatrogenic factors. Nasal problems can be grouped into mucosal, structural, and sensory causes.

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Mucosal causes include: allergic, nonallergic, and occupational rhinitis, environmental irritants, rhinosinusitis, gastroesophageal and laryngopharyngeal reflux, tobacco abuse, nasal cycle, drug induced, inflammatory disorders, endocrine and metabolic disorders, and pregnancy. Structural causes include: internal nasal calve pinching, external nasal valve narrowing and/or collapse, internally recurvate lateral crura, wide columella from short medial crura, septal deviation, deviated nasal bones, synechiae, septal perforation, turbinate hypertrophy, concha bullosa, nasal polyps or tumor, adenoid hypertrophy, and thick nasal vibrissae. Sensory causes include: atrophic rhinitis, empty nose syndrome, trauma, congenital idiopathic hypesthesia, and unreasonable expectations (Recker, 2016). A photo of unilateral nasal valve collapse is shown below.

Figure 10. Unilateral Nasal Valve Collapse (Recker, 2016).



In 2018, Wise and colleagues published an international consensus statement on allergy and rhinology, detailing causative and contributory factors (Wise, 2018). The article shows that drug-induced rhinitis can be caused by local inflammatory drugs such as NSAIDS, aspirin, and ketorolac, neurogenic and neuromuscular drugs such as alpha- and beta-adrenergic receptor modulators, phosphodiesterase inhibitors, and ACE inhibitors, and finally idiopathic drugs such as psychotropics, immunomodulators, hormones, and antihypertensives. They also cite high-risk occupations for occupational

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rhinitis. These include: bakers/food industry (cereal flours), laboratory workers (laboratory animals), healthcare workers (latex, drugs), farmers (animal-derived and plant allergens, mold), seafood workers (shellfish, bony fish), pharmaceutical and detergent industries (biological enzymes), hairdressers (persulphates), carpentry (wood dust), chemical factories (mixture of irritants), and cleaners (mixture of irritants) (Wise, 2018).

According to a systematic review published in 2010, septal deviation is associated with an increased prevalence of rhinosinusitis, although the impact is limited. They too, concluded that there are many possible factors that might lead to the development of rhinosinusitis and nasal obstruction (Orlandi, 2010).

Unfortunately, trauma also contributes to the etiology of nasal obstruction. Nasal fractures have been reported as 1 of the 3 most common pediatric facial bone fractures. The most commonly fractured facial bones in children are the nasal bones and the mandible, with the former occurring more frequently due to the reduced force required for fracture. Kopacheva-Barsova and colleagues cite that the most common causes of nasal fractures in this age group are auto accidents, usually involving bicyclists or pedestrians (40%), sports injuries (25%), intended injuries such as weight lifting (15%), and home injuries (10%). Child abuse also must be considered. Generally, the incidence of injury increases with age and peaks between 16 and 20 years. However, fractures of the facial bones are uncommon in children under five years of age because the greater part of the nasal skeleton is cartilaginous. Nasal bone fractures do not occur as frequently as in adults. Luckily, most of these injuries are minor. (Kopacheva-Barsova, 2016).

The Korean National Health and Nutrition Survey 2008-2012 determined several risk and protective factors for nasal obstruction. The authors found that male sex was a

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risk factor for chronic rhinosinusitis and nasal septal deviation. Aging was a risk factor for chronic rhinosinusitis with nasal polyps but a protective factor for allergic rhinitis. Also, a lower level of education and obesity were risk factors for chronic rhinosinusitis with nasal polyps. Urban residence was a risk factor for allergic rhinitis. Finally, nasal septal deviation was a risk factor for chronic rhinosinusitis without nasal polyps (Ahn, 2016).

In 2018, Horwitz reported associations based on CBCT analysis, periapical x-rays, clinical dental examination and the visual analog scale questionnaire. Most patients reported ENT symptoms, and a significant correlation was found between the presence of polyps in the sinus and a decrease in smell/taste. Obstruction of the sinus meatus was associated with coughing; turbidity was associated with ear congestion. Thickening of the Schneiderian membrane showed an association with both coughing and ear congestion. The mean number of missing posterior teeth correlated with postnasal drip and nasal congestion. Finally, periapical pathology was associated with nasal discharge/runny nose (Horwitz, 2018).

Equally as important is to determine what factors do not increase risk for nasal obstruction. Yasan and colleagues concluded that a mild to moderate degree of nasal septal deviation was not a causitive factor for chronic sinus disease. Only gross deviation of the septum increased the risk of developing chronic rhinosinusitis (Yasan, 2005). Additionally, a systematic review concluded that there is no convincing evidence that a reduction in nasal airflow is a causative factor for rhinitis or sinusitis (Boyce, 2006). This is important when considering whether or not anatomical obstruction is to blame for congestion.

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Changes in Nasal Obstruction with Growth and Aging

When identifying and/or treating nasal obstruction, it is important to consider how growth and aging may affect the midface. This begins around the time of birth. Generally, the hospital data in this area varies significantly between sites. Kawalski and colleagues noted that on the fetal head, the distance between the nasal tip and the external occipital protuberance is relatively large. Based on this concept, it makes sense that the nose, being the most prominent part of the face, is particularly liable to birth injury. Fortunately, Kawalski and colleagues found that cartilaginous septum deviations occurring during delivery are straightened spontaneously during the first days of life (Kawalski, 1998).

Nasal septum deformities can be classified by shape, and they change with age. Beate's study used Mladina's classifications. They found that nasal septal deviation was more prevalent in boys, and not surprisingly, there was increased risk of nasal septum deformities increases after facial trauma. Types 1 and 5 dominated in their study population. Type 1 decreased with age, while type 5 increased with age. Their literature review revealed that after age 20, the prevalence of nasal septal deviations is unchanged. It correlation to the completion of development of the nasomaxillary complex and a reduction in nasal trauma. (Beate, 2006).

Min's study, however, reported that nasal septum deformities increased until age 49. This trend is not seen elsewhere in the scientific literature. Therefore, the authors attributed this discrepancy to delayed effects of nasal trauma (Y.G. Min, 1995).

Although the septum changes throughout life, Lindemann and colleagues reported insignificant changes in patient-reported nasal obstruction. Analysis of the NOSE and

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SNOT questionnaires revealed no deterioration in the quality of life of the elderly related to changes in nasal function. In fact, nasal cavities enlarge as people age and acoustic rhinometry findings supported this (Lindemann, 2010). In another study, maxillofacial CT scans were measured, and the authors found that only the internasal angle increased with age (Serifoglu, 2017). Considering nasal cavities become larger with age, this is theoretically plausible.

Special attention should be given to patients with cleft lip and/or palate, because the deformities affect nasal airway volume and septal deviation patterns. Starbuck and colleagues found that nasal airway volumes were reduced on the clefted sides relative to non-clefted sides of the face. Nasal airway volumes strongly increased with age, agreeing with literature for normal patients, whereas septal deviation values increased slightly with age (7-18 years). Their results suggest that nasal breathing may be impaired in individuals born with the unilateral and bilateral cleft lip and palate deformity (Starbuck, 2014).

Prevalence of Nasal Obstruction/Allergic Rhinitis in Different Populations

As previously mentioned, it is difficult to estimate the true prevalence of nasal obstruction. Stewart's article summarized the epidemiologic effects of congestion caused by nasal mucosal inflammation, the primary pathophysiologic mechanism underlying congestion in the common upper respiratory disorders, in an effort to shed light on nasal obstruction. Allergic rhinitis is a main cause of congestion, and was the primary focus of the article. The article cited that the prevalence of allergic rhinitis has been increasing worldwide. Estimates of its prevalence vary greatly, from 10% to 40%. Nonstandardized diagnostic criteria and differences in methodology and patient population contribute to

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this discrepancy. It is generally accepted, however, that about 10% to 20% of the global population suffers from allergic rhinitis. Increased awareness by the public and physicians may contribute to a perceived increase in prevalence. Still, the true prevalence of allergic rhinitis is likely underestimated, because epidemiologic research relies heavily on physician diagnosis, and those undiagnosed or self-medicating are not accounted for (Stewart, 2010).

In 2018, Clark and colleagues published a popular study of 1,906 patients with sinonasal complaints detailing the prevalence of certain anatomic contributors to nasal airway obstruction. Patients completed the Nasal Obstruction Symptom Evaluation (NOSE) instrument to assess the related symptoms and their severity. Three anatomic contributors, including nasal valve collapse, septal deviation, and turbinate hypertrophy were measured. Patients showed a prevalence of 67% for nasal valve collapse, 76% for septal deviation, and 72% for inferior turbinate hypertrophy. 64% of the patients had severe or extreme NOSE scores. In this group of patients, the prevalence of nasal valve collapse, septal deviation, and inferior turbinate hypertrophy was 73%, 80%, and 77%, respectively. 82% of the patients with severe or extreme NOSE scores who underwent prior septoplasty and/or inferior turbinate reduction had symptomatic nasal valve collapse, showing the importance of addressing all possible factors of obstruction pre-surgically. Despite the severity of the NOSE scores, all three anatomic contributors showed similar distribution and prevalence (Clark, 2018).

In a Swedish study of 1,469 people, the proportion of people suffering from any type of nose complaint was 26.7% in the city group (mean age 42±19 years), and 24.1% in the rural group (mean age 47±19 years) (Jessen, 1997). This coincides with Fettman's

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review, stating that up to one-third of the population complains of nasal obstruction and seeks treatment from their physicians (Fettman, 2009).

The Korean National Health and Nutrition Survey included symptom-based criteria for allergic rhinitis, and was defined using only allergic rhinitis symptoms (sneezing, rhinorrhea, nasal obstruction, and nasal itching) lasting for several days regardless of a common cold in the previous 12 months. The survey showed that the prevalence of allergic rhinitis was 27.5%. After adjusting for allergen frequency in Korea, the re-estimated prevalence was 18.5%. Using an otorhinolaryngologic interview and nasal endoscopy, this extensive, nationwide epidemiologic study of 35,511 people produced an updated national prevalence for Koreans of 2.6%, 5.8%, 18.5%, and 48.0% for chronic rhinosinusitis with nasal polyps, chronic rhinosinusitis without nasal polyps, allergic rhinitis, and nasal septal deviation, respectively (Ahn, 2016).

In 2019, Zhang and colleagues shared their findings from a population of children with cleft lip and palate, a population more likely to have nasal obstruction. Results from the NOSE scale indicated 67% percent of subjects had nasal obstruction at some point during the study period, with 49% reporting nasal obstruction at the latest follow-up. Patients 14 years or older reported the most severe symptoms. Those with cleft lip and alveolus and unilateral cleft lip and palate reported more severe nasal blockage than other phenotypes. Additionally, subjects with a history of either posterior pharyngeal flap or sphincter pharyngoplasty had significantly higher NOSE scores than subjects with no history of speech surgery. They concluded that, among the cleft lip and palate population, there are more severe nasal obstructive symptoms in those older than 14, those with cleft

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lip and alveolus or unilateral cleft lip and palate, and those with a history of posterior pharyngeal flap or sphincter pharyngoplasty (Zhang, 2019).

In terms of gender differences, some articles have reported a slightly higher nasal septal deviation prevalence in males (Rao, 2005) (Ahn, 2016). Though statistically insignificant, nasal septal deviation was more commonly encountered in females (60.4%) in Janovic's study (Janovic, 2020). Nasal septal deviation is the most common anatomic contributor to nasal obstruction (Clark, 2018), so its prevalence is the best representation of nasal airway obstruction in the existing literature.

Diagnosis of Nasal Obstruction

Diagnosis of nasal obstruction has been extensively studied in an effort to standardize it. In a 2018 systematic review, Mohan and colleagues reported that there is no *objective* measure of nasal airway obstruction that can be considered a criterion standard. Structural measures of flow, pressure, and volume are necessary but insufficient (Mohan, 2018)." They recommend further exploration to create an ideal instrument to aid in objective measurement of nasal obstruction. Lindsay and colleagues noted that nasal obstruction was a common chief complaint at their otolaryngology clinic, but there had not been a comprehensive standardized worksheet to anatomically or objectively measure this obstruction (Lindsay, 2016).

However, there is a subjective measure that has been validated and supported in the literature. "Of the *subjective* measures available for nasal airway obstruction, the NOSE scale is outstanding with regard to disease-specific validation and correlation with symptoms (Mohan, 2018)." Because nasal airway obstruction has considerable effects

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on quality of life, “an adequate diagnosis begins with a focused history and physical examination and requires a patient quality of life measure such as the NOSE scale. Objective measures should be adjunctive and require further validation for widespread adoption (Mohan, 2018).” Details of the NOSE survey will be presented later in this document.

Imaging has been explored as a tool for diagnosis, and evidence is conflicting. Codari and colleagues worked to assess whether three-dimensional morphometric parameters could be useful in nasal septal deviation diagnosis and, secondarily, whether CBCT could be considered an adequate imaging technique for diagnosis. CBCT scans were analyzed and morphometric parameters were computed, including septal deviation angle, volume difference between the right and left sides of the airway, nasal airway total volume and a new synthetic septal deviation index. Differences between the groups were found in septal deviation angle, in volume percentage difference, and in the septal deviation index. They concluded that the new septal deviation index measurement was best for the quantitative assessment of nasal septal deviation, and CBCT allowed accurate assessment of airway morphology (Codari, 2016).

The following article presents another way to classify septal deviation from a three-dimensional image. Using geometric morphometrics, Radulesco and colleagues devised a classification system for septal deviations, based on the concept that the deviated septum varies in form. Three-dimensional segmentation models derived from CT scans were retrospectively analyzed from patients with and without septal deviation. Thirty landmarks were used to define septal conformations and two clusters were identified for the patients with septal deviation: s-shaped and c-shaped. Additionally, there was a

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significant difference regarding nasal resistance between the septal deviation group and the control group. The authors suggest further research regarding the link between nasal septal conformation and function to improve diagnosis (Radulesco, 2019).

An article by Orhan and colleagues reported another use of CT as a diagnostic tool for nasal obstruction. They aimed to describe the connection between the severity of nasal septum deviation and inferior turbinate hypertrophy using paranasal sinus CTs in patients with deviated septum. The control group was considered to be the normal inferior turbinates on the deviated side and the experimental group to be the hypertrophic inferior turbinates in the same patient. They concluded that both mucosal hypertrophy and hypertrophy of the inferior turbinate bone itself contributes to turbinate hypertrophy in patients with septal deviation. Lastly, they suggested that the assistance of preoperative CT is helpful when determining surgical techniques to address hypertrophic turbinates (Orhan, 2014).

Although the previous studies supported the use of imaging in diagnosis of nasal obstruction, there are several articles that did not find significant value in this method. Particularly, insurance companies often require imaging for surgical authorization, and some practitioners do not believe this is necessary. Using the validated NOSE scale, the following study aimed to determine whether septal deviation findings on computed tomography correlate with symptoms of nasal obstruction. Ardeshirpour and colleagues found little correlation between the two. Therefore, they concluded that a role for CT scans is neither clinically meaningful nor necessary to diagnose uncomplicated nasal obstruction (Ardeshirpour, 2016).

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Sedaghat and colleagues performed nasal endoscopy and assessed radiographs to explore this relationship. They found a significant correlation between physical examination and radiographic assessment of septal deviation only at the bony septum with low quantitative agreement. No significant correlation was detected at the cartilaginous septum, inferior septum, or as expected, nasal valve. They concluded, therefore, that clinical decisions should be based on physical examination and not radiographic evidence (Sedaghat, 2015).

Along these lines, Janovic's study showed that CT morphology and the angle of septal deviation did not predict the severity of nasal obstruction (Janovic, 2020). They, too, concluded that requesting CT examination solely to confirm nasal obstruction is not justified (Janovic, 2021).

The final diagnostic topic to consider is septal deviation classification. C-shaped and S-shaped conformations, as previously mentioned, represent just a few. A systematic review from 2016 summarized various classification systems, and found that most septal deviations can be summarized by C-shaped or reverse C-shaped, as well as S-shaped or reverse S-shaped deviations. For radiographic studies, assorted groups of points have been identified along the septum. Overall, terminology varies greatly throughout the literature. Deviations have been classified as Grades 1-3, Degrees I-III, Types I-IV, and Types 1-6. There have been diverse measurements in caudal, anteroposterior, and vertical dimensions, indicating that some dimensions are more important than others. Deviation classifications have also been measured based on deviation from the midline, proximity to the inferior turbinate, and proximity to the lateral nasal wall. Measurements

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include ratios and raw measurements. The inconsistencies led the authors to conclude that standardization would facilitate diagnosis and future research (Teixeira, 2016).

Validation of the NOSE Scale

In order for a diagnostic instrument, such as the NOSE scale, to become a standard, it must first be validated. In 2004, Stewart and colleagues created a *disease-specific health status instrument* to identify nasal obstruction. First, they created an alpha, or preliminary, version of potential questions. Next, they performed a prospective study to evaluate for item performance, correlation with anatomy, internal consistency, specificity, and test-retest reliability, as well as construct, discriminant, criterion validity, and responsiveness. Four academic medical centers and 32 adults with nasal septal deformity were included. Items with poor performance and those that reduced internal consistency were eliminated from the alpha-version, resulting in the elimination of 4 items. 2 of the remaining 6 items, “trouble breathing through nose” and “having to breathe through mouth,” correlated highly (0.698). This means that these 2 topics measured a similar underlying construct. Elimination of the mouth breathing topic resulted in a higher internal consistency of the final version, so it was removed. This is especially important to consider in the field of orthodontics, where an item covering mouth breathing would be helpful. Although research is necessary in this area, orthodontists can consider the patients’ reports of “trouble breathing through nose” as potential mouth breathing.

The final version included 5 items on a 5-point Likert scale. It produced an adequate test-retest reliability (0.702); internal consistency reliability was also adequate (Cronbach’s $\alpha = 0.785$). The sensitivity was very high, with a standardized response mean of 1.66 and an effect size of 2.65. Correlation with and comparison to physical anatomy

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was used to confirm validity, and response sensitivity was excellent. Ultimately, the authors successfully produced an instrument to identify nasal obstruction. They concluded that "the Nasal Obstruction Symptom Evaluation Scale is a valid, reliable, and responsive instrument that is brief, easy to complete and can be used for outcomes studies in adults with nasal obstruction. The NOSE Scale could also be used with a *global* or generic quality of life instrument, to assess the relative impact of the specific disease on different aspects of global quality of life (Stewart, 2004 "Development")." The alpha-version is shown below.

Figure 11. Alpha Version of the NOSE Instrument (Stewart, 2004 "Development").

Nasal Obstruction Symptom Evaluation (NOSE) Instrument

Physician AAO-HNS#: _ _ _ _ _ Today's date: _ _/_ _/_ _ _ _

→ **To the Patient:** Please help us to better understand the impact of nasal obstruction on your quality of life by **completing following survey**. Thank You!

Over the past 1 month, how much of a problem were the following conditions for you?

	Please circle the most correct response				
	Not a problem	*very mild problem*	*moderate problem*	*fairly bad problem*	*severe problem*
1. Nasal congestion or stuffiness	0	1	2	3	4
2. Poor sense of smell	0	1	2	3	4
3. Snoring	0	1	2	3	4
4. Nasal blockage or obstruction	0	1	2	3	4
5. Trouble breathing through my nose	0	1	2	3	4
6. Trouble sleeping	0	1	2	3	4
7. Having to breathe through my mouth	0	1	2	3	4
8. Unable to get enough air through my nose during exercise or exertion	0	1	2	3	4
9. Feeling panic that I cannot get enough air through my nose	0	1	2	3	4
10. Embarrassment around friends and coworkers because I have trouble breathing through my nose	0	1	2	3	4
	Poor	*Fair*	*Good*	*Very good*	*Excellent*
11. In general, my health is	0	1	2	3	4

Please mark on this line how troublesome is your difficulty in breathing through your nose:

None — Medium — Severe

Fig 1. The alpha-version of the NOSE instrument. (The NOSE Scale © 2003, the American Academy of Otolaryngology–Head and Neck Surgery Foundation.)

In 2013, a study from Stanford University was published to develop a classification system for the severity of the NOSE scale results to aid in interpretation. The authors created 4 classes of severity: mild (range, 5-25), moderate (range, 30-50), severe (range, 55-75), and extreme (range, 80-100) nasal obstruction (Lipan, 2013)"

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In 2020, Din and colleagues published psychometric evaluation of the NOSE scale. They included 136 patients, aged 8-18 years old, who completed pre- and postoperative evaluations. Internal consistency of the scale was even higher than that upon validation (Cronbach's α = 0.83). Item response models indicated that the questions were able to capture low to moderate levels of nasal obstruction in their population. Because the original validation used a study sample of adults, the more recent study provided validation in the pediatric population. The authors concluded that "the Nasal Obstruction Symptom Evaluation scale is a robust tool that may be incorporated as a *subjective* evaluation of severity of nasal obstruction among pediatric patients undergoing a septoplasty or functional septorhinoplasty (Din, 2020)."

Validation of the NOSE Scale: Adaptation in Other Languages

Due to the success of health-related quality of life questionnaires as instruments for outcome assessments and disease-related qualities of life, many other countries have adapted the NOSE scale to assess nasal obstruction. To do so, validation of the screening was required in their respective languages to ensure similar meaning when translated. The Polish adaptation cited the general difficulty in correlating objective and subjective methods, and also cited the NOSE scale's effectiveness (Dąbrowska-Bień, 2018). The cross-cultural adaptation and validation process also demonstrated validity in Brazil (Portuguese) and Turkey (Bezerra, 2011) (Onerci, 2018). The German adaptation was among the most recent, citing previous validation in the French, Greek, Chinese, Italian, Slovenian, Dutch, Spanish, and Arabic languages (Spiekermann, 2018) (Marro, 2011) (Lachanas, 2014) (Dong, 2014) (Mozzanica, 2013) (Urbančič, 2016) (Larrosa, 2015) (Amer, 2017).

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Further Validation of the NOSE Scale

Since validation of the NOSE scale, many studies have cited findings that strengthen its use. Mohan's systematic review states that the NOSE scale is outstanding with regard to disease-specific validation and correlation with symptoms among the subjective methods of measuring nasal airway obstruction. The authors conclude that not only is the NOSE scale outstanding, but also required for diagnosis. Because no objective measure can be considered the gold standard, this is a weighty statement (Mohan, 2018).

Although the original validation cited the NOSE scale's potential use as a *global*, or population, quality of life instrument, the following studies support its use for individual recognition of nasal obstruction. In 2012, Kahveci and colleagues evaluated the efficiency of Nasal Obstruction Symptom Evaluation (NOSE) scale for septoplasty outcomes in comparison with other examination methods. Correlation was found between NOSE scores and examination and computed tomography findings, indicating that the patient-reported symptoms related well to physical obstruction caused by septal deviation and its correction. The article's conclusion stated that the NOSE scale is a very useful tool to evaluate the effectiveness of pure septoplasty (Kahveci, 2012), supporting its anatomical accuracy.

Similarly, in 2016, Lindsay and colleagues worked to identify the relationship between specific findings from clinical examination and the Nasal Obstruction Symptom Evaluation score. Using a standardized nasal anatomy worksheet, the inferior turbinates, nasal septum, and internal and external nasal valve narrowing and collapse were graded bilaterally from a scale of 0 to 3. They found that NOSE scores correlated with the mean total anatomic worksheet score, indicating overall obstruction rather than specific

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anatomic contributors. As a result, the authors concluded that the total nasal anatomic score correlates to patient-reported, nasal-specific quality of life (Lindsay, 2016).

In Weitzman's study of unilateral versus bilateral nasal obstruction, a significant correlation was reported between Nasal Obstruction Symptom Evaluation (NOSE) scores and all individual exam findings. Additionally, multiple linear regression revealed that total, left, and right septal deviation, as well as total, left, and right internal valve narrowing were all predictive of an increased NOSE score. Unilateral and bilateral septal deviation and internal nasal valve narrowing were also predictive of having an increased NOSE score (Weitzman, 2020). This further supports the accuracy of the NOSE score's use as an individual screening tool.

Lee and colleagues evaluated the relationship between subjective symptoms of nasal obstruction (NOSE scale) and the corresponding nasal anatomical parameters using paranasal computed tomography. Although every anatomical structure did not correlate with subjective nasal obstruction symptoms, the septal deviation angle and the nasal cavity cross-sectional area at the ostiomeatal unit and the choana levels did have significant correlation (Lee, 2013). However, the conflicting evidence in the literature about radiographic evaluation of nasal obstruction must be taken into consideration when reading studies evaluating anatomy using CT rather than physical/clinical evaluation.

Finally, Kahraman and colleagues studied patients, grouped by operation, undergoing septoplasties. The patients completed the NOSE scale pre- and postoperatively, and measurements for allergic rhinitis were taken. The authors observed that nasal findings were correlated with NOSE scores (Kahraman, 2016). Generally, the evidence supporting correlation of NOSE scores with anatomy is strong, so the objectives

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of recent studies in this area do not typically include evaluation of the NOSE scale's validity. These correlations are often found as secondary data in less-related studies.

Evidence that Does Not Support Correlation of Anatomy with NOSE Scale

Overall, the available scientific evidence strongly supports the correlation of NOSE scores with physical obstruction. However, there are some studies that found no correlation. For example, Thomas and colleagues found that nasal obstruction correlated weakly with disease-specific qualities of life and had no correlation with the Pittsburgh Sleep Quality Index total (Thomas, 2016). Because the NOSE scale includes a "trouble sleeping" item, and because the Pittsburgh Sleep Quality Index includes items addressing mouth breathing and nasal obstruction, it is logical to explore correlation between the two instruments.

Üstün's findings from preoperative and postoperative NOSE scores showed no statistically significant correlation of singular intranasal pathologies with their respective surgical techniques (Üstün, 2019). Although the creators of the NOSE scale did not claim it correlates with specific individual anatomy, this has been found in other studies. If used as an individual screening tool, this is important to consider.

Finally, Verhoeven and colleagues did not find a statistical difference in VAS scores between the different types and severities of septal deviation (Verhoeven, 2016). Although this study did not utilize the NOSE scale, it used another validated, subjective, patient-reported scale to measure severity.

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NOSE: Guidelines for Intervention/Follow-up

Currently, there are no guidelines for intervention based on NOSE scores. One recent study suggested that scores ≥55 represent the most likely candidates for intervention (Clark, 2018). In another study, upon development of severity classifications for the NOSE score, a receiver operating characteristic curve analysis was performed to determine a point which would best separate those with and without nasal obstruction. Authors concluded that a NOSE score of 30 best differentiated these patients. In this case, nasal airway obstruction was patient-reported, and those without obstruction were seeking solely cosmetic rhinoplasty (Lipan, 2013). Thomas and colleagues also defined symptomatic nasal obstruction as a NOSE score ≥ 30 (Thomas, 2016). A recently published Australian normative study noted that Medicare added the NOSE score threshold of >45 as criteria for surgical funding (Stefani, 2020). Another suggested a score of 50 because this was just outside the mean and because in a logistic regression, 50 corresponded to a 50% probability of having an Epworth Sleepiness Scale score (measuring obstructive sleep apnea) higher than 10 (Ishii, 2011). Of patients that received intervention, based on the NOSE scores, most (63%) patients had severe (37%) or extreme (26%) nasal obstruction, 24% reported moderate nasal obstruction, and 11% had mild nasal obstruction (Clark, 2018).

NOSE: Minimum Important Difference

The minimal detectable change in NOSE scores must be considered to determine what scores are clinically significant. Stewart and colleagues found that following septoplasty, the minimal detectable change was only 3.9 to 5.9 points (Stewart, 2004 “Outcomes”). Ziai and Bonaparte found that in patients with septal deviation, an

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improvement of approximately 40% in their nasal obstructive symptoms as assessed by the NOSE questionnaire is required to define a nasal airway surgery as successful (Ziai, 2017). In another study, improvement of NOSE scores greater than 22 points was predictive of improvement in Patient Health Questionnaire-2 score (Speth, 2019), which screens for depression. Despite these findings, there are still no widely-accepted guidelines.

Uses of the NOSE Scale

Primarily, the NOSE scale has been used as an outcome assessment for septoplasty. Septal correction as a surgical procedure is still relevant in today's world for symptomatic betterment and for a healthier lifestyle. A 40% improvement in the NOSE scores postoperatively is often cited, as stated by Ziai and Bonaparte (Ziai, 2017) (Muthubabu, 2019).

In some studies assessing these septoplasty outcomes, the frequency of NOSE scale responses to specific questions has been reported separately from the entire NOSE score. In Muthubabu's population, "nasal blockage" was most commonly reported, followed by "trouble breathing through the nose" and "nasal congestion." It is logical that nasal blockage is most commonly reported in patients seeking septoplasty, because that question implies more of an anatomical rather than inflammatory or allergic obstruction. These three categories also showed the greatest improvements after treatment (Muthubabu, 2019).

The NOSE questionnaire has also been utilized in continuous positive airway pressure (CPAP) research. Lebret and colleagues note that because nasal obstruction is

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frequently reported by patients with sleep apnea, it complicates the choice of mask for CPAP therapy. The authors therefore concluded that the NOSE questionnaire could be a simple decision-making tool to determine whether to provide a nasal or oronasal mask during CPAP initiation (Lebret, 2018).

Due to its correlation with anatomical contributors to obstruction, the NOSE scale has also been used to evaluate surgical outcomes other than septoplasties. Specifically, a systematic review and meta-analysis utilized preoperative and postoperative Nasal Obstruction Symptom Evaluation scores to evaluate the effectiveness of functional rhinoplasty for the treatment of nasal airway obstruction caused by lateral nasal wall insufficiency (Kandathil, 2018).

The NOSE survey has also been cited in obstructive sleep apnea (OSA) literature. The rationale for its use includes the fact that many patients undergoing sinonasal surgery have undiagnosed OSA or nasal obstruction, a known risk factor for OSA. Patients with OSA have unique perioperative needs, so this should be addressed. Ishii and colleagues reported that patients with nasal obstruction, a deviated septum, and/or snoring, show a correlation between the NOSE score and the Epworth Sleepiness Scale (ESS) score. The authors concluded that the NOSE survey may serve as a simple screening instrument instead of the ESS for patients at risk for undiagnosed OSA and special perioperative needs. Considering the high frequency of sinonasal surgery in the United States, even a small percentage of interventions could be significant (Ishii, 2011).

The NOSE scale as even been used to investigate the effects of surgical treatment for nasal airway obstruction on sexual functions. Pre- and post-operative surveys for both perceived nasal obstruction with the Nasal Obstruction Symptom Evaluation

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questionnaire and sexual functions with the International Index of Erectile Function were administered. The authors found that surgical treatment of nasal obstruction by septoplasty, endoscopic sinus surgery, concha bullosa excision or radiofrequency can significantly improve sexual performance (Cayir, 2019).

Additionally, the NOSE scale has been used to investigate nasal obstruction's relationship with inflammatory diseases of the middle ear. Authors hypothesized that unilateral chronic otitis media correlates with the side of nasal obstruction, but their findings did not support their hypothesis (Toros, 2013).

The NOSE scale has also been used to evaluate the utility of other or new diagnostic tools. For example, Fuller and colleagues reported that the lack of a strong correlation between peak nasal inspiratory flow (PNIF) valves and NOSE score limits PNIF's utility as a diagnostic tool for nasal airway obstruction. They state that PNIF may, however, be a more useful tool to measure an individual's objective nasal airway obstruction changes following surgery (Fuller, 2018). When the validity of PNIF fell short, the authors suggested an objective alternative. Conflicting literature exists, so they did not accept that the NOSE scale has been shown to correlate well with anatomy.

Finally, the NOSE has served as a surgical outcome assessment for middle turbinate lateral lamella resection alone with septoplasty plus middle turbinate lateral lamella resection for nasal stuffiness in two patient groups (Sağıt, 2013). The range of procedures and fields that have successfully adapted the NOSE scale since its creation in 2004 supports its expansion into related fields such as orthodontics.

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Sleep-Disordered Breathing has been Studied at Length in Orthodontics

Sleep-disordered breathing has been studied at length in orthodontics. A thorough and wide range of related topics have been published, including clinical guidelines, oral appliance therapy, sleep-disordered breathing in children, and even hyoid arch displacement with hypoglossal nerve stimulation (Epstein, 2009) (Marklund, 2019) (Rohra, 2018) (ElShebiny, 2017).

Abtahi and colleagues found that there is a higher pediatric sleep-disordered breathing risk prevalence in the orthodontic population compared with the healthy pediatric population. The authors suggested that orthodontic practitioners should make sleep-disordered breathing screening a routine part of their clinical practice (Abtahi, 2020). Due to the close relationship between sleep-disordered breathing and nasal obstruction, this evidence also suggests that implementation of the NOSE scale would be useful in orthodontics.

The importance of the relationship between breathing and orthodontics has been supported in the literature, and interdisciplinary care is often necessary. Fortunately, this concept has been supported by Case Western Reserve University. Recently, Case Western Reserve University and the Cleveland Clinic built a Health Education Campus where medical, nursing, dental and physician assistant students learn, study and dine together. In this way, they can learn with and from each other. This proves useful in the case of nasal obstruction, where the orthodontist acts as part of a team: to identify risk. The Board of Trustees of the American Association of Orthodontists organized a panel of medical and dental experts in sleep medicine and dental sleep medicine to offer guidelines for this role. One of the official guidelines stated that there is no indication

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that prophylactic application of maxillary expansion prevents the future development of OSA (Behrents, 2019). Following these guidelines, orthodontists would not expand in patients if not orthodontically warranted. Boundaries like these are important to consider when implementing the NOSE survey in orthodontic practice, due to nasal obstruction's multidisciplinary nature.

What Treatments Could Patients Receive When Referred to an ENT?

After identifying nasal obstruction, the role of an orthodontist may include referral to an ENT for further evaluation. Therefore, it is important to know for what interventions he or she may be referring. In 2015, a clinical practice guideline for allergic rhinitis was published. The authors put together action statements that included the fact that clinicians should recommend intranasal steroids and/or antihistamines for patients with a clinical diagnosis of allergic rhinitis whose symptoms affect their quality of life. The importance placed on quality of life, similar to the NOSE survey, should be noted. Additional treatments cited in the guidelines include specific IgE (skin or blood) allergy testing and exploration of the presence of associated conditions such as asthma, atopic dermatitis, sleep-disordered breathing, conjunctivitis, rhinosinusitis, and otitis media. Sublingual or subcutaneous immunotherapy, pharmacologic mono- or combination therapy, and environmental controls, such as removal of pets, the use of air filtration systems, bed covers, and acaricides, were also recommended in certain situations. The panel recommended against clinicians routinely performing sinonasal imaging in patients presenting with symptoms consistent with a diagnosis of allergic rhinitis. This is consistent with some of the previously presented literature, that deemed radiographic imaging for confirmation of nasal obstruction unnecessary (Janovic, 2021) (Ardeshirpour, 2016)

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(Sedaghat, 2015). Surgical management with inferior turbinate reduction, for example, was also cited. Finally, acupuncture was presented for patients requesting nonpharmacologic therapy (Seidman, 2015).

Van Egmond noted that septoplasty, surgical correction of the deviated nasal septum, is the most frequently performed ear, nose, and throat operation in adults. Therefore, referring doctors such as orthodontists can expect this to be a possibility for intervention. A randomized controlled trial in the Netherlands of 203 subjects showed that septoplasty is more effective than non-surgical management for nasal obstruction in adults with a deviated septum. The primary outcome was health-related quality of life (van Egmond, 2019).

Another possible intervention is functional septorhinoplasty. In a 2019 study, authors administered NOSE surveys pre- and postoperatively. They concluded that patients with nasal obstruction who undergo functional septorhinoplasty can be expected to feel significant improvements in as early as 1 to 3 months postoperatively (Gerecci, 2019). This is another piece of information with which referring doctors should be familiar.

Patients may undergo several surgical procedures at one time. For example, a patient may have both a functional septorhinoplasty and inferior turbinate reduction. In 2019, Yamasaki and colleagues assessed the NOSE scores and the EuroQol-5 Dimension Questionnaire Visual Analog Scale for general health-related qualities of life preoperatively and periodically postoperatively. They concluded that functional septorhinoplasty results in a sustained, long-term improvement in nasal obstruction, with incremental improvement in quality of life outcomes with the addition of inferior turbinate reduction (Yamasaki, 2019). The available literature supports increases in quality of life

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measures postoperatively, which is necessary for referring doctors to be comfortable with referral.

What Can Orthodontists Do?

Orthodontists prescribe skeletal expansion when necessary. Besides the dental and skeletal benefits of coordinating the maxillary and mandibular widths, numerous studies report the additional benefits of skeletal expansion. Maspero and colleagues report its effects on the nasal septum. The maxillary complex and the nasal septum were evaluated on three-dimensional images following rapid maxillary expansion in growing children. Cephalometric tracings revealed that the nasal septum was modified in its length more significantly in its lower rather than its upper tract. The width of the piriform aperture increased of 1.58 mm with an increase in the lateral walls and a downward movement of the nasal floor. There was also a reduction of septal deviation. The authors concluded that “rapid maxillary expansion can result in: a potentially positive effect on the nasal septum asymmetry during childhood, an increase of the nasal cavity volume due to a downward and forward movement, a lateral inclination of the nasal cavity reducing air resistance and improving breathing pattern, an increase of the length of the septum in its lower third improving its possible deviations and growth disturbances and favorable effects on the growth of the entire maxillary complex (Maspero, 2019).”

A recent study by Zhao and colleagues reported a computational fluid dynamics analysis. Three-dimensional models of adolescent patients’ airways were derived from CBCT images before and after expansion with the MSE (Maxillary Skeletal Expansion) appliance. Changes in cross-sectional area, airflow velocity, pressure, and total resistance at maximum expiration and inspiration were determined after maxillary skeletal

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expansion. The greatest increase in area occurred in the oropharynx (40.65%). The average increase in area was 7.42% in the nasal cavity and 22.04% in the pharynx. These results suggest that treatment of maxillary constriction using the MSE appliance may increase area of the upper airway and reduce upper airway resistance and velocity (Zhao, 2020).

“It is well established in the literature that maxillary expansion, both in adults and children, increases upper airway volume (Calvo-Henriquez, 2021).” A very recent systematic review and meta-analysis explored patient-reported nasal-obstructive symptoms before and after palatal expansion. The data revealed a statistically significant reduction in nasal resistance after palatal expansion. Additionally, the NOSE scores showed a significant mean reduction of 40.08 points post-expansion. Though the evidence does not support skeletal expansion as a primary treatment method for nasal obstruction, the data supports improvement in nasal function after palatal expansion (Calvo-Henriquez, 2021).

Another recent systematic review reported that tooth-bone-borne rapid palatal expansion significantly improved nasal airflow and reduced nasal resistance (Abu Arqub, 2021).

Finally, it has been reported that patients experienced a subjective improvement or did not have a worsening of nasal obstruction symptoms after SARME, surgically-assisted rapid maxillary expansion (Menegat, 2015).

Though the effects of maxillary skeletal expansion can be beneficial to nasal function, it is not a primary treatment. For example, even if a patient was referred to an

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orthodontist by an ENT, the orthodontist should not expand if not skeletally or dentally warranted. The relatively new capability to expand in adults using skeletal anchorage is exciting for improvement of upper airway function. However, there is still no indication in the literature that prophylactic application of maxillary expansion prevents the future development of OSA (Behrents, 2019).

There is no existing literature on the prevalence of nasal obstruction measured by NOSE scores in an orthodontic population. Due to the potential positive effects on patients' qualities of life, patients should be treated orthodontically when appropriate and referred to an ENT and upon recognition of symptomatic obstruction.

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STATEMENT OF THESIS

Our objective was to determine the prevalence of nasal airway obstruction indicated by the NOSE scale in the population seeking orthodontic treatment. A second objective was to determine if there is a significant difference between the prevalence of nasal airway obstruction in a residency program versus a corporate or private practice.

Hypotheses:

1. The prevalence of nasal airway obstruction will reflect or exceed its prevalence in the general population.
2. There is no significant difference in the distribution of NOSE scores between a residency program, a corporate practice, and a private practice.

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PREVALENCE OF PATIENT-REPORTED NASAL AIRWAY OBSTRUCTION IN AN ORTHODONTIC POPULATION

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Introduction

Nasal airway obstruction is common in the general population [1]. Anatomically, it can be the result of nasal septal deviation, turbinate hypertrophy, nasal valve collapse, nasal polyps, adenoid hypertrophy, allergic rhinitis (nasal allergies) or rhinosinusitis (sinus infection) [2-4]. This obstruction often results in mouth breathing and compromised tongue position which can cause adverse craniofacial and dental effects such as Angle Class II malocclusion with increased anterior facial height, retrognathic maxilla and mandible, increased overjet, and constricted transverse maxillary dimension [5]. Other symptoms include mouth breathing, nasal crusting, epistaxis, and sinusitis [6]. Chronic nasal obstruction is also associated with snoring, daytime sleepiness, and obstructive sleep apnea (OSA) [7]. Finally, depression and anxiety are more common and severe in patients with nasal septal deviation [8].

Although obstructive sleep apnea is studied at length in orthodontics [9-12], less attention is paid to nasal airway obstruction, and there is no gold standard in orthodontics for identification and referral. The Nasal Obstruction Symptom Evaluation (NOSE) scale is one instrument used to identify nasal airway obstruction [3]. This evaluation tool has 5 items on a 5-point (0-4) Likert scale. Patients add their scores and multiply by 5, and the resulting score is 0-100. It was originally verified for use as a disease-specific (nasal obstruction) health status instrument in 2004 [3]. A study in 2016 determined that NOSE scores correlated with specific nasal anatomic scores from physical examination [13]. A recent psychometric evaluation of the NOSE scale concluded that it may be incorporated

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as a subjective evaluation of severity of nasal obstruction among pediatric patients undergoing a septoplasty or functional septorhinoplasty [14]. Additionally, the NOSE scale may serve as a simple screening instrument for pediatric patients at risk for OSA [7]. A recent study suggested that a score ≥55 indicates intervention [2]. Others suggested a score ≥ 30 [15,16]. Most (63%) patients who received intervention based on the NOSE scores had severe (37%) or extreme (26%) nasal obstruction. 24% reported moderate nasal obstruction, and 11% had mild nasal obstruction. The minimal detectable change in NOSE scores must be considered to determine what scores are clinically significant. Stewart and colleagues found that following septoplasty, the minimal detectable change was only 3.9 to 5.9 points [3].

The NOSE scale is usually used not to report prevalence, but to compare pre- and post-operative symptoms. However, it can also be used as a screening instrument [7]. To our knowledge, no studies have evaluated the prevalence of nasal obstruction using the NOSE scale in an orthodontic population. Therefore, the objective of this study is to determine the prevalence of nasal airway obstruction indicated by the NOSE scale in the population seeking orthodontic treatment. A second objective is to determine if there is a significant difference between the prevalence of nasal airway obstruction in a residency program versus a corporate or private practice.

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Materials and Methods

This study was approved by the Institutional Review Board of Case Western Reserve University. The sample consisted of 431 patients seeking orthodontic care who completed the NOSE survey (Figure 1) between February 2020 and April 2021 at Case Western Reserve University School of Dental Medicine in the Orthodontic Department (CWRU), a private practice (Solon, OH), and a corporate office (Fairlawn, OH).

Patient birthdate, gender, presence of seasonal allergies, and history of trauma were collected on the NOSE survey. Inclusion criteria consisted of good general health, ability to read and write in English, and having completed the NOSE survey and health history forms. Patients with craniofacial anomalies, such as cleft lip and palate and syndromes, were excluded from this sample. Each patient signed a consent form allowing the use of orthodontic records for research purposes. Patients' responses were reviewed. The prevalence of nasal airway obstruction was determined. Scores of the NOSE survey were multiplied by 5, and were categorized as zero, mild (5-25), moderate (30-50), severe (55-75) or extreme (80-100). NOSE scale questions were assessed to determine the most frequently marked responses. Health histories were reviewed for the sample of patients at CWRU who scored "moderate" or above to check for data validity.

SPSS software (version 26.0; SPSS, Chicago, Ill) was used for all statistical analyses, and significance levels for all tests were set at $p \leq 0.05$. The Shapiro-Wilk test suggested that the data was not normally distributed (Figure 2). NOSE scores from private practice were entered twice in SPSS to assess reliability. The Chi Square test was used to determine if there was a significant difference between males and females in our sample. The overall prevalence of nasal airway obstruction, prevalence in each category

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and prevalence at each location were determined. The Mann-Whitney U test was used to determine the relationship between NOSE (scores/categories) and age, gender, presence of seasonal allergies, and history of trauma. Correlations of NOSE scores and seasonal allergies with age were evaluated with the Spearman's rank correlation coefficient (rho).

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Results

The sample consisted of 431 patients from the three locations (268 females and 163 males); average age was 23.1 ± 13.5 years, ranging from 7-78. Descriptive data showing sample size in each location is shown in Table 1 and Figure 3. The Chi-Square test showed a significant difference between males and females in our sample ($p < 0.05$) (Table 2). 100% of data (715/715 data points) was entered accurately (ICC = 1.0). The mean of all NOSE scores was 8.4 ± 14.7 (95% confidence interval 7.0-9.8), ranging from 0-80 on a scale of 100. The Kruskal-Wallis Test showed no significant difference in NOSE score distribution between an orthodontic residency program, a corporate practice, and a private practice ($p = .113$). 43.9% (95% CI: 39.1%-48.7%) of patients reported at least "mild" nasal airway obstruction. 11.4% (95% CI: 8.6%-14.9%) of patients reported at least "moderate" nasal airway obstruction. 2.6% (95% CI: 1.3-4.5%) of patients reported "severe" nasal airway obstruction. 0.2% (95% CI: 0.0-1.3%) of patients reported "extreme" nasal airway obstruction (Table 3). Descriptive data for NOSE category by location is shown in Table 4. In this sample, patient-reported nasal airway obstruction as indicated by the NOSE scale was not correlated with age, gender, nor trauma ($p < 0.05$). There was a significant correlation between NOSE scores and seasonal allergies ($p = .000$). We also found a significant correlation between seasonal allergies and age (Spearman's rho: $p = .006$, Mann-Whitney U: $p = .020$) indicating that the adult population reported a higher prevalence of seasonal allergies than did the pediatric population. The first item on the NOSE survey, "nasal congestion or stuffiness," was most commonly reported (Table 5)

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and had the most “fairly bad” or “severe” responses at 5.3% (95% CI: 3.4%-7.9%). NOSE scale questions showed that “fairly bad” or “severe” responses represented 3.4% (95% CI: 2.7%-4.3%) of responses (Table 6), and 9.5% (95% CI: 6.9%-12.7%) of patients reported “fairly bad” or “severe” problems. Finally, 91.2% of patients scoring “moderate” or above from the population at CWRU reported a related symptom on another form. This indicates that patients responded consistently between the NOSE survey and other screening forms.

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Table 1. Sample Distribution by Location

Location	**Patient Count**	**% of Total**
CWRU	315	73.1%
Corporate	61	14.2%
Private Practice	55	12.8%
Total	**431**	**100.0%**

Table 2. Sample Distribution by Gender

Gender	**Patient Count**	**% of Total**	**P Value**
Male	163	37.8%	p = .000
Female	268	62.2%	
Total	**431**	**100.0%**	

Table 3. Prevalence of NOSE Categories

NOSE Category	**Patient Count**	**% of Total**
Zero	242	56.1%
Mild	140	32.5%
Moderate	37	8.6%
Severe	11	2.6%
Extreme	1	0.2%
Total	**431**	**100.0%**
Total w/ Mild or Above	*189*	*43.9%*
Total w/ Moderate or Above	*49*	*11.4%*

Table 4. NOSE Category by Location

NOSE Category	**CWRU**	**Corporate**	**Private Practice**
Zero	59.0%	49.2%	47.3%
Mild	30.2%	42.6%	34.5%
Moderate	7.6%	6.6%	16.4%
Severe	3.2%	1.6%	0.0%
Extreme	0.0%	0.0%	1.8%
Total	**100.0%**	**100.0%**	**100.0%**
Total w/ Mild or Above	*41.0%*	*50.8%*	*52.7%*
Total w/ Moderate or Above	*10.8%*	*8.2%*	*18.2%*

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Table 5. NOSE Scale Frequency by Question

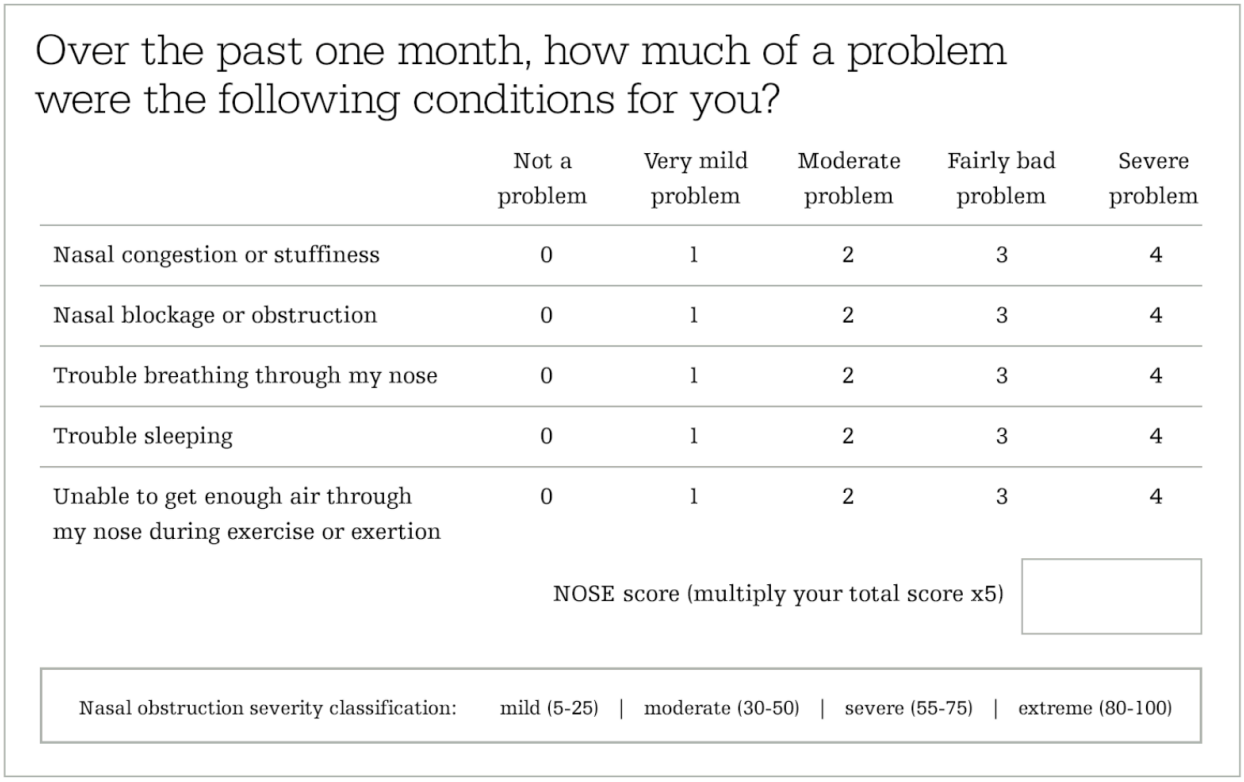
NOSE Question	Patient Count	% of Total	As a % w/Score >0
Congestion / Stuffiness	134	31.1%	70.9%
Blockage / Obstruction	72	16.7%	38.1%
Trouble Breathing	76	17.6%	40.2%
Trouble Sleeping	93	21.6%	49.2%
Limited Nasal Breathing on Exercise	73	16.9%	38.6%

Table 6. “Fairly Bad” or “Severe” Responses

NOSE Questions	Patient Count	% of Responses
Congestion / Stuffiness	23	5.3%
Blockage / Obstruction	12	2.8%
Trouble Breathing	12	2.8%
Trouble Sleeping	17	3.9%
Limited Nasal Breathing During Exercise	10	2.3%
Total "Fairly Bad" or "Severe" Responses	**74**	**3.4%**

Figures

Figure 1. NOSE Scale, obtained from https://ent.stryker.com/conditions/nasal-airway-obstruction



Over the past one month, how much of a problem were the following conditions for you?

	Not a problem	Very mild problem	Moderate problem	Fairly bad problem	Severe problem
Nasal congestion or stuffiness	0	1	2	3	4
Nasal blockage or obstruction	0	1	2	3	4
Trouble breathing through my nose	0	1	2	3	4
Trouble sleeping	0	1	2	3	4
Unable to get enough air through my nose during exercise or exertion	0	1	2	3	4

NOSE score (multiply your total score x5)

Nasal obstruction severity classification: mild (5-25) | moderate (30-50) | severe (55-75) | extreme (80-100)

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Figure 2. Data Normality

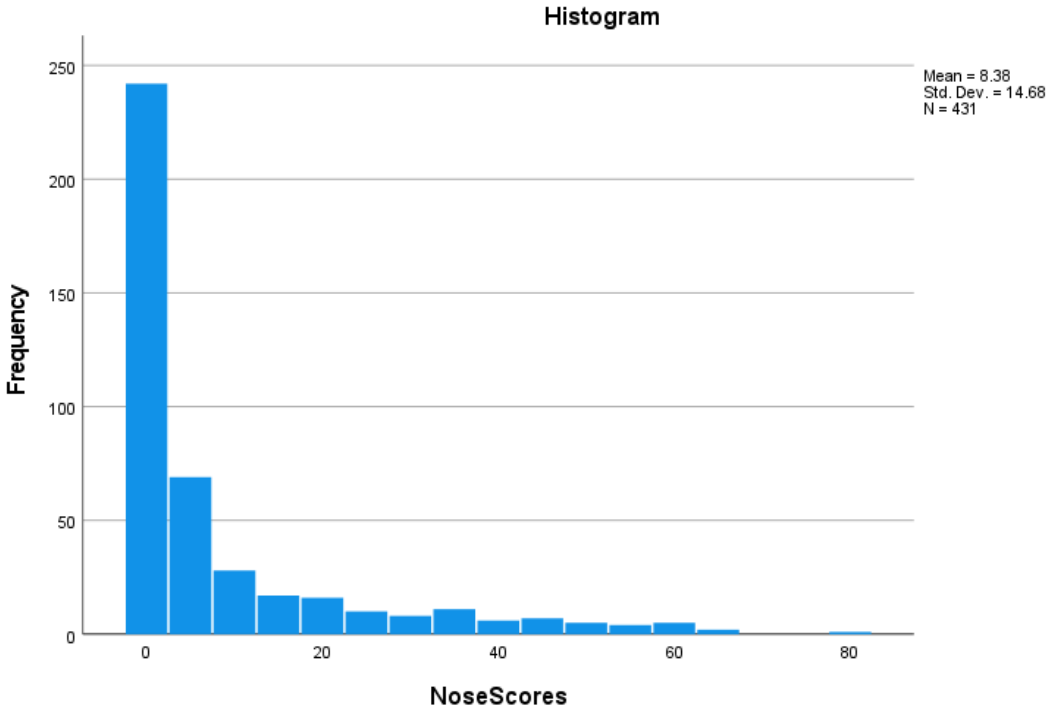
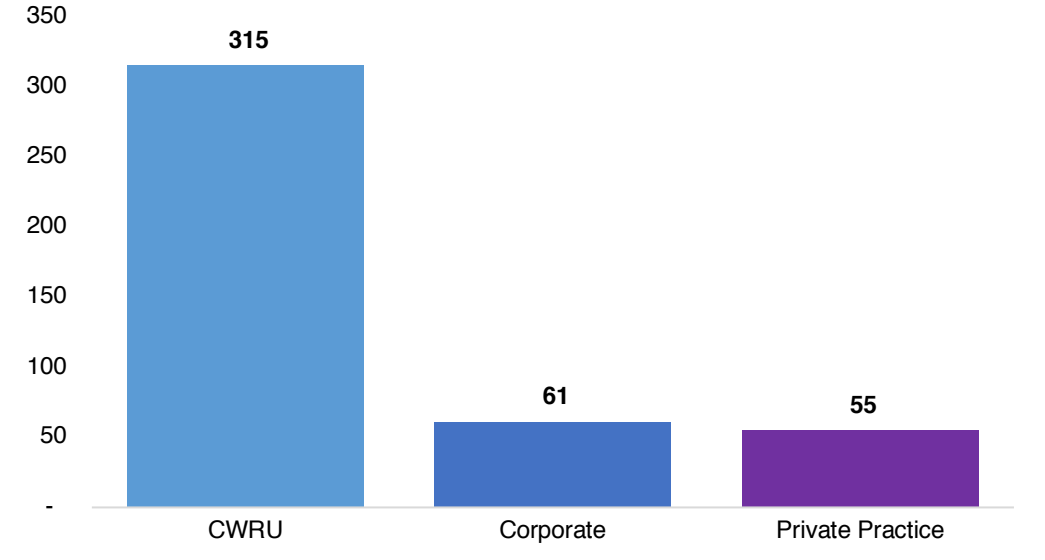


Figure 3. Patients by Location



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Discussion

In this sample, patient-reported nasal airway obstruction as indicated by the NOSE scale was not correlated with gender, age, nor trauma. Our results concur with the literature regarding gender and age [18]. Although trauma has been reported as a risk factor for a higher NOSE score [19], we did not find a correlation. History of facial trauma was gathered retrospectively from the patients' medical history forms, reading "any injuries to face, head, neck?" The vague nature of this question may have diluted the relevant and possibly significant cases of trauma.

Not surprisingly, we found a significant correlation between NOSE scores and seasonal allergies ($p = .000$). Surprisingly, however, we found a correlation between seasonal allergies and age (Spearman's rho: $p = .006$, Mann-Whitney U: $p = .020$) indicating that the adult population reported a higher prevalence of seasonal allergies than did the pediatric population. This conflicts with existing literature, stating that the prevalence of seasonal allergic rhinitis is higher in children and adolescents than adults [20].

The mean NOSE score of 8.4 ± 14.7 (95% CI: 7.0-9.8) is lower than that reported from most other populations [21,22,7]. This is due to the dissimilar nature of our sample populations. NOSE scores have traditionally been reported from patients undergoing septoplasties or other surgical procedures. It is logical that the prevalence of symptomatic nasal obstruction in patients seeking care for nasal obstructive problems is higher than that of an orthodontic population, which is more similar to the general population. Normative data was recently published based on the general Australian population, however, and our mean NOSE score falls within

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the standard deviation of theirs (16 ± 18.89)[19]. Our mean NOSE score also falls within range of Lipan's study (11.3 ± 15) and is most similar to the mean score reported in the Dutch adaptation of the NOSE scale (8.5 ± 13)[15,23].

Almost half of our population (43.9%) reported at least mild nasal obstruction. This is higher than that reported in a study from Sweden of 1469 people, where 26.7% of people in the city group and 24.1% in the rural group suffered from any type of nose complaint [20]. Estimates of the prevalence of allergic rhinitis in the scientific literature vary from 10-40%, but it is generally accepted that 10-20% of the global population suffers from allergic rhinitis alone [1]. The prevalence of symptomatic nasal obstruction in general, considering the addition of structural contributors, nasal polyps, and rhinosinusitis, would be higher. Therefore, we believe our reported prevalence represents or slightly exceeds the true prevalence of mild nasal obstruction in the general population. It may also slightly exceed that of the general population due to patients' awareness of skeletal issues, such as maxillary transverse constriction or mandibular retrognathia, prompting them to seek treatment.

Although there is no gold standard for follow-up or intervention in the literature, a score of "moderate" or above (≥30) seems to indicate true nasal obstruction. This means that we should refer or follow up with about 1 in 10 (11.4%) of our orthodontic patients regarding nasal obstruction. At the very least, we can reinforce the benefits of nasal breathing to improve our patients' qualities of life. This prevalence relates well to the results of Australian normative data, reporting 9.6% of patients had a NOSE score >45 [19].

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Finally, 2.8% of patients had severe or extreme scores, which represents at least 1 patient per day in an orthodontic practice.

The first item on the NOSE survey, “nasal congestion or stuffiness,” was most commonly reported and had the most “fairly bad” or “severe” responses at 5.3% (95% CI: 3.4%-7.9%). Another study surveyed patients for septoplasty outcome assessments and showed highest prevalence of “nasal blockage or obstruction [24].” “Nasal blockage or obstruction” sounds most similar to true anatomic obstruction, for which patients may seek surgical treatment. This is not the case in orthodontics, however, so the prevalence of each item is probably more representative of the general population. Additionally, 70.9% of people who scored >0 marked “nasal congestion or stuffiness.” This supports Stewart’s epidemiologic report on the high prevalence and significant social and economic burden of nasal congestion [1].

3.4% of all responses were “fairly bad” or “severe.” In our opinion, this severity requires follow-up questions. 9.5% of patients reported at least one “fairly bad” or “severe” problem on the survey, which cannot be ignored. Not only should orthodontists give attention to high overall NOSE scores, but also to the ”3s” and “4s” in each item. Considering the large patient volume whom orthodontists treat, 49 patients per day on average [25], this prevalence indicates that 4 patients per day fall in this category. In our experience, a patient may notate the cause of the issue if he or she feels the problem is unrelated to nasal obstruction.

There was no significant difference in NOSE score distribution between an orthodontic residency program, a corporate practice, and a private practice. This

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indicates that our results are applicable for clinicians in corporate and private practices.

Due to the retrospective nature of this study, we were not able to retest a subset of our population. Therefore, we checked data validity by comparing consistency of patient responses across forms. 91.2% of symptomatic patients reported a related symptom on another screening form. This confirmed that patients were attentive when completing the NOSE survey.

Interesting descriptive statistics were also gathered. For example, almost two-thirds (62.2%) of patients seeking orthodontic care were female. This difference was found to be statistically significant ($p = .000$). At age <12, the distribution of patients by age was 50/50. The only age group where males outnumbered females was age 18-20, and that was only by 4%. Additionally, 72% of patients older than 26 years old were female, indicating that more female adults seek orthodontic care than do male adults.

While traditionally, orthodontic populations have been considered pediatric, the mean age (23.1 ± 13.5) and range (ages 7-78) of our population reflects the great variety of age groups now seeking orthodontic treatment. This represents an older population than was reported by orthodontists in 2016 [25].

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Conclusions

- The results indicate the prevalence of at least mild nasal airway obstruction in orthodontic populations was 43.9% (95% CI: 39.1%-48.7%), representing or slightly exceeding that of the general population.
- About 1 in 10 (11.4%) orthodontic patients reported at least moderate nasal obstruction, indicating the need for follow-up or referral.
- 9.5% (95% CI: 6.9%-12.7%) of patients reported “fairly bad” or “severe” problems in the NOSE scale.
- There was no significant difference in NOSE score distribution between an orthodontic residency program, a corporate practice, and a private practice. The results collected at CWRU are applicable to most clinicians.
- Orthodontic practitioners should make the NOSE survey a routine part of their clinical practice because we have the opportunity to treat and refer patients, when appropriate, to improve their qualities of life.

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APPENDICES

Appendix 1: IRB Approval

IRB Administration Offices
UH IRB Phone: 216.844.1529
CWRU IRB Phone: 216.368.6925

INITIAL APPROVAL

Principal Investigator:	Juan Palomo
Title:	Nasal Septal Deviation and Nasal Airway Obstruction in an Orthodontic Population
Submission Number:	STUDY20201155
IRB Office:	CWRU IRB
Approval Date:	5/3/2021
Effective Date:	5/3/2021
Approval End Date	N/A
Type of Submission:	Initial Study
Type of Review:	Expedited
Documents Reviewed:	• HRP-600 - HIPAA Request for Waiver Form, Category: Other; • Nasal Septal Deviation and Nasal Airway Obstruction in an Orthodontic Population, Category: IRB Protocol;

The IRB has reviewed this submission.

- Per Federal regulation, changes MAY NOT be made to any element of the current research without prior IRB approval, except to eliminate an immediate and apparent hazard to subjects enrolled in the study.
- Per Federal regulation, the research may not continue beyond the Approval End date. You must submit a continuing review form 6-8 weeks before this Approval End date in order to maintain IRB approval. Failure to maintain IRB approval is human subjects non-compliance. Please note that even if your study falls into a category that does not require an Approval End date, the institution may require a yearly "check-in" to confirm the status of the study.

***Approval by the IRB does NOT mean that you have permission to start your study. Prior to starting your study, you may be required to obtain (1) a coverage analysis for studies that involve patient care, regardless of source of funding, and/or (2) a contract with the Sponsor of your study or an agreement with any third-party collaborator that may receive UH or CWRU patient information in any format. Please ensure that all required approvals are obtained before initiation of research activity. ***

The UH IRB operates under HHS Federalwide Assurance (FWA) number 00003937 and IRB registration numbers 00000684, 00001691 and 00008600. The CWRU IRB operates under DHHS FWA00004428 and IRB registration number 00000683.

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Appendix 2: Additional Descriptive Tables

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	431	7.1	78.2	23.1	13.5

Patients with Seasonal Allergies		
NOSE Category	N	% of Category
Zero	24	9.9%
Mild	25	17.9%
Moderate	16	43.2%
Severe	6	54.5%
Extreme	1	100.0%
Total	**72**	**16.7%**

NOSE Category (Excluding Patients with Seasonal Allergies)			
NOSE Category	Patient Count	% of Total	% Delta vs. Total
Zero	218	60.7%	4.6%
Mild	115	32.0%	(0.4%)
Moderate	21	5.8%	(2.7%)
Severe	5	1.4%	(1.2%)
Extreme	-	0.0%	(0.2%)
Total	**359**	**100.0%**	
Total w/ Mild or Above	*141*	*39.3%*	*(4.6%)*
Total w/ Moderate or Above	*26*	*7.2%*	*(4.1%)*

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Patients with Seasonal Allergies		
Age Group	# of Patients	% of Age Group
< 18	29	12.9%
≥ 18	43	20.9%
Total	**72**	**16.7%**

Age Group Characteristics			
Age Group	# of Patients	Mean Age	Std. Deviation
< 18	225	13.7	2.0
≥ 18	206	33.4	13.3
Total	**431**	**23.1**	**13.5**

NOSE Scale Questions (Excluding Patients with Seasonal Allergies)				
NOSE Question	Patient Count	% of Total	As a % w/ Score >0	Reduction
Congestion / Stuffiness	90	20.9%	63.8%	(32.8%)
Blockage / Obstruction	49	11.4%	34.8%	(31.9%)
Trouble Breathing	50	11.6%	35.5%	(34.2%)
Trouble Sleeping	65	15.1%	46.1%	(30.1%)
Limited Nasal Breathing During Exercise	51	11.8%	36.2%	(30.1%)

NOSE Score Severity by Age as a % of Age Group		
Age Group	Mild & Above	Moderate & Above
< 18	42.7%	8.7%
≥ 18	45.1%	14.6%
Total	**43.9%**	**11.4%**

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Q1: "Nasal Congestion or Stuffiness"			
Severity of Problem	Frequency	% of Total	Cumulative %
0	297	68.9%	68.9%
1	85	19.7%	88.6%
2	26	6.0%	94.7%
3	19	4.4%	99.1%
4	4	0.9%	100.0%
Total	**431**	**100.0%**	**100.0%**
Patients Reporting 3 or Above	*23*	*5.3%*	

Q2: "Nasal Blockage or Obstruction"			
Severity of Problem	Frequency	% of Total	Cumulative %
0	359	83.3%	83.3%
1	45	10.4%	93.7%
2	15	3.5%	97.2%
3	10	2.3%	99.5%
4	2	0.5%	100.0%
Total	**431**	**100.0%**	**100.0%**
Patients Reporting 3 or Above	*12*	*2.8%*	

Q3: "Trouble Breathing Through My Nose"			
Severity of Problem	Frequency	% of Total	Cumulative %
0	355	82.4%	82.4%
1	39	9.0%	91.4%
2	25	5.8%	97.2%
3	10	2.3%	99.5%
4	2	0.5%	100.0%
Total	**431**	**100.0%**	**100.0%**
Patients Reporting 3 or Above	*12*	*2.8%*	

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Q4: "Trouble Sleeping"			
Severity of Problem	Frequency	% of Total	Cumulative %
0	338	78.4%	78.4%
1	49	11.4%	89.8%
2	27	6.3%	96.1%
3	13	3.0%	99.1%
4	4	0.9%	100.0%
Total	**431**	**100.0%**	**100.0%**
Patients Reporting 3 or Above	*17*	*3.9%*	

Q5: "Unable to Get Enough Air Through My Nose During Exercise or Exertion"			
Severity of Problem	Frequency	% of Total	Cumulative %
0	358	83.1%	83.1%
1	44	10.2%	93.3%
2	19	4.4%	97.7%
3	8	1.9%	99.5%
4	2	0.5%	100.0%
Total	**431**	**100.0%**	**100.0%**
Patients Reporting 3 or Above	*10*	*2.3%*	

NOSE Score Category by Age (CWRU Only)						
Age	Zero	Mild	Moderate	Severe	Extreme	Total
< 12	11	3	-	-	-	**14**
12 - 14	60	32	4	3	-	**99**
15 - 17	26	10	4	-	-	**40**
18 - 20	9	8	1	1	-	**19**
21 - 23	11	7	-	1	-	**19**
24 - 26	11	6	2	-	-	**19**
> 26	58	29	13	5	-	**105**
Total	**186**	**95**	**24**	**10**	-	**315**
Mean Age	*23*	*25*	*28*	*26*	-	

NOSE Score Category by Age as a % of Age Group (CWRU Only)						
Age	Zero	Mild	Moderate	Severe	Extreme	Total
< 12	5.9%	3.2%	0.0%	0.0%	-	4.4%
12 - 14	32.3%	33.7%	16.7%	30.0%	-	31.4%
15 - 17	14.0%	10.5%	16.7%	0.0%	-	12.7%
18 - 20	4.8%	8.4%	4.2%	10.0%	-	6.0%
21 - 23	5.9%	7.4%	0.0%	10.0%	-	6.0%
24 - 26	5.9%	6.3%	8.3%	0.0%	-	6.0%
> 26	31.2%	30.5%	54.2%	50.0%	-	33.3%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	-	**100.0%**

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NOSE Score Category by Age (Corporate Only)						
Age	Zero	Mild	Moderate	Severe	Extreme	Total
< 12	1	5	-	-	-	**6**
12 - 14	8	5	1	-	-	**14**
15 - 17	5	6	1	-	-	**12**
18 - 20	3	3	-	1	-	**7**
21 - 23	3	1	-	-	-	**4**
24 - 26	1	-	-	-	-	**1**
> 26	9	6	2	-	-	**17**
Total	**30**	**26**	**4**	**1**	-	**61**
Mean Age	*22*	*21*	*23*	*18*	-	

NOSE Score Category by Age as a % of Age Group (Corporate Only)						
Age	Zero	Mild	Moderate	Severe	Extreme	Total
< 12	3.3%	19.2%	0.0%	0.0%	-	9.8%
12 - 14	26.7%	19.2%	25.0%	0.0%	-	23.0%
15 - 17	16.7%	23.1%	25.0%	0.0%	-	19.7%
18 - 20	10.0%	11.5%	0.0%	100.0%	-	11.5%
21 - 23	10.0%	3.8%	0.0%	0.0%	-	6.6%
24 - 26	3.3%	0.0%	0.0%	0.0%	-	1.6%
> 26	30.0%	23.1%	50.0%	0.0%	-	27.9%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	-	**100.0%**

NOSE Score Category by Age (Private Practice Only)						
Age	Zero	Mild	Moderate	Severe	Extreme	Total
< 12	8	7	1	-	-	**16**
12 - 14	7	8	2	-	1	**18**
15 - 17	3	1	2	-	-	**6**
18 - 20	1	-	-	-	-	**1**
21 - 23	-	-	-	-	-	-
24 - 26	-	-	1	-	-	**1**
> 26	7	3	3	-	-	**13**
Total	**26**	**19**	**9**	-	**1**	**55**
Mean Age	*20*	*18*	*25*	-	*13*	

NOSE Score Category by Age as a % of Age Group (Private Practice Only)						
Age	Zero	Mild	Moderate	Severe	Extreme	Total
< 12	30.8%	36.8%	11.1%	-	0.0%	29.1%
12 - 14	26.9%	42.1%	22.2%	-	100.0%	32.7%
15 - 17	11.5%	5.3%	22.2%	-	0.0%	10.9%
18 - 20	3.8%	0.0%	0.0%	-	0.0%	1.8%
21 - 23	0.0%	0.0%	0.0%	-	0.0%	0.0%
24 - 26	0.0%	0.0%	11.1%	-	0.0%	1.8%
> 26	26.9%	15.8%	33.3%	-	0.0%	23.6%
Total	**100.0%**	**100.0%**	**100.0%**	-	**100.0%**	**100.0%**

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Patient Age Distribution by Location			
Age	CWRU	Corporate	Private Practice
< 12	4.4%	9.8%	29.1%
12 - 14	31.4%	23.0%	32.7%
15 - 17	12.7%	19.7%	10.9%
18 - 20	6.0%	11.5%	1.8%
21 - 23	6.0%	6.6%	0.0%
24 - 26	6.0%	1.6%	1.8%
> 26	33.3%	27.9%	23.6%
Total	**100.0%**	**100.0%**	**100.0%**

	NOSE Category by Location					
NOSE Category	CWRU	Corporate	Private Practice	CWRU	Corporate	Private Practice
Zero	186	30	26	59.0%	49.2%	47.3%
Mild	95	26	19	30.2%	42.6%	34.5%
Moderate	24	4	9	7.6%	6.6%	16.4%
Severe	10	1	-	3.2%	1.6%	0.0%
Extreme	-	-	1	0.0%	0.0%	1.8%
Total	**315**	**61**	**55**	**100.0%**	**100.0%**	**100.0%**
Total w/ Mild or Above	*129*	*31*	*29*	*41.0%*	*50.8%*	*52.7%*
Total w/ Moderate or Above	*34*	*5*	*10*	*10.8%*	*8.2%*	*18.2%*

	NOSE Category by Location (Excluding Seasonal Allergies)					
NOSE Category	CWRU	Corporate	Private Practice	CWRU	Corporate	Private Practice
Zero	165	30	23	63.5%	53.6%	53.5%
Mild	78	23	14	30.0%	41.1%	32.6%
Moderate	12	3	6	4.6%	5.4%	14.0%
Severe	5	-	-	1.9%	0.0%	0.0%
Extreme	-	-	-	0.0%	0.0%	0.0%
Total	**260**	**56**	**43**	**100.0%**	**100.0%**	**100.0%**
Total w/ Mild or Above	*95*	*26*	*20*	*36.5%*	*46.4%*	*46.5%*
Total w/ Moderate or Above	*17*	*3*	*6*	*6.5%*	*5.4%*	*14.0%*

	Delta of Total vs. Total After Excluding Seasonal Allergies					
NOSE Category	CWRU	Corporate	Private Practice	CWRU	Corporate	Private Practice
Zero	(21)	-	(3)	4.4%	4.4%	6.2%
Mild	(17)	(3)	(5)	(0.2%)	(1.6%)	(2.0%)
Moderate	(12)	(1)	(3)	(3.0%)	(1.2%)	(2.4%)
Severe	(5)	(1)	-	(1.3%)	(1.6%)	0.0%
Extreme	-	-	(1)	0.0%	0.0%	(1.8%)
Total	**(55)**	**(5)**	**(12)**	**(0.0%)**	**(0.0%)**	**0.0%**
Total w/ Mild or Above	*(34)*	*(5)*	*(9)*	*(4.4%)*	*(4.4%)*	*(6.2%)*
Total w/ Moderate or Above	*(17)*	*(2)*	*(4)*	*(4.3%)*	*(2.8%)*	*(4.2%)*

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NOSE Category by Gender				
NOSE Category	Male Count	% of Males	Female Count	% of Females
Zero	85	52.1%	157	58.6%
Mild	57	35.0%	83	31.0%
Moderate	17	10.4%	20	7.5%
Severe	3	1.8%	8	3.0%
Extreme	1	0.6%	-	0.0%
Total	**163**	**100.0%**	**268**	**100.0%**
Total w/ Mild or Above	*78*	*47.9%*	*111*	*41.4%*
Total w/ Moderate or Above	*21*	*12.9%*	*28*	*10.4%*

NOSE Category by Age					
Age	Zero	Mild	Moderate	Severe	Extreme
< 12	20	15	1	-	-
12 - 14	75	45	7	3	1
15 - 17	34	17	7	-	-
18 - 20	13	11	1	2	-
21 - 23	14	8	-	1	-
24 - 26	12	6	3	-	-
> 26	74	38	18	5	-
Total	**242**	**140**	**37**	**11**	**1**
Mean Age	*23*	*23*	*27*	*25*	*13*

NOSE Category by Age as a % of Age Group					
Age	Zero	Mild	Moderate	Severe	Extreme
< 12	55.6%	41.7%	2.8%	0.0%	0.0%
12 - 14	57.3%	34.4%	5.3%	2.3%	0.8%
15 - 17	58.6%	29.3%	12.1%	0.0%	0.0%
18 - 20	48.1%	40.7%	3.7%	7.4%	0.0%
21 - 23	60.9%	34.8%	0.0%	4.3%	0.0%
24 - 26	57.1%	28.6%	14.3%	0.0%	0.0%
> 26	54.8%	28.1%	13.3%	3.7%	0.0%
Total	**56.1%**	**32.5%**	**8.6%**	**2.6%**	**0.2%**

Patient Gender by Location						
Gender	CWRU #	CWRU %	Corporate #	Corporate %	Private Practice #	Private Practice %
Male	120	38.1%	21	34.4%	22	40.0%
Female	195	61.9%	40	65.6%	33	60.0%
Total	**315**	**100.0%**	**61**	**100.0%**	**55**	**100.0%**

Patient Age Group by Location						
Age	CWRU #	CWRU %	Corporate #	Corporate %	Private Practice #	Private Practice %
< 18	153	48.6%	32	52.5%	40	72.7%
≥ 18	162	51.4%	29	47.5%	15	27.3%
Total	**315**	**100.0%**	**61**	**100.0%**	**55**	**100.0%**

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NOSE Score Severity by Age as a % of Age Group		
Age	Mild & Above	Moderate & Above
< 12	44.4%	2.8%
12 - 14	42.7%	8.4%
15 - 17	41.4%	12.1%
18 - 20	51.9%	11.1%
21 - 23	39.1%	4.3%
24 - 26	42.9%	14.3%
> 26	45.2%	17.0%
Total	**43.9%**	**11.4%**

Patient Age @ NOSE Survey		
Age	Patient Count	% of Total
< 12	36	8.4%
12 - 14	131	30.4%
15 - 17	58	13.5%
18 - 20	27	6.3%
21 - 23	23	5.3%
24 - 26	21	4.9%
> 26	135	31.3%
Total	**431**	**100.0%**
Mean Age	*25*	
Standard Deviation	*14*	

Male Patient Age @ NOSE Survey				
Age	Male Count	% of Total	% of Males	% of Age Group
< 12	18	4.2%	11.0%	50.0%
12 - 14	55	12.8%	33.7%	42.0%
15 - 17	25	5.8%	15.3%	43.1%
18 - 20	14	3.2%	8.6%	51.9%
21 - 23	6	1.4%	3.7%	26.1%
24 - 26	7	1.6%	4.3%	33.3%
> 26	38	8.8%	23.3%	28.1%
Total	**163**	**37.8%**	**100.0%**	**37.8%**
Male Mean Age	*22*			

Female Patient Age @ NOSE Survey				
Age	Female Count	% of Total	% of Females	% of Age Group
< 12	18	4.2%	6.7%	50.0%
12 - 14	76	17.6%	28.4%	58.0%
15 - 17	33	7.7%	12.3%	56.9%
18 - 20	13	3.0%	4.9%	48.1%
21 - 23	17	3.9%	6.3%	73.9%
24 - 26	14	3.2%	5.2%	66.7%
> 26	97	22.5%	36.2%	71.9%
Total	**268**	**62.2%**	**100.0%**	**62.2%**
Female Mean Age	*24*			

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Appendix 3: Raw Data

						NOSE Score Data								
Patien	Location	Date of Scr	DoB	Gender	Age @ Scr	NOSE Scor	NOSE Scor	NOSE Scor	NOSE Scor	NOSE Scor	OSE Score	Severit	Trauma	eas. Aller
0129Q	CWRU	11/2/2020	9/17/1942	F	78.2	-	-	-	-	-	-	Zero	No	No
0697T	CWRU	2/21/2021	3/7/1994	M	27.0	-	1	-	1	-	10	Mild	Yes	No
0920T	CWRU	12/15/2020	5/13/2002	M	18.6	-	-	-	1	-	5	Mild	No	No
1641U	CWRU	12/11/2020	12/9/1983	F	37.0	-	-	-	-	-	-	Zero	No	No
1705Z	CWRU	12/9/2020	3/11/1986	F	34.8	-	-	-	-	-	-	Zero	No	No
1738F	CWRU	3/4/2021	8/23/1948	F	72.6	2	1	-	1	-	20	Mild	No	Yes
2147U	CWRU	12/18/2020	3/16/1960	F	60.8	1	1	1	1	1	25	Mild	No	Yes
2244Z	CWRU	3/8/2021	1/22/2003	M	18.1	-	-	-	-	-	-	Zero	No	No
2682Q	CWRU	3/2/2020	3/11/1988	F	32.0	-	-	-	-	-	-	Zero	Yes	No
3842S	CWRU	3/31/2021	11/24/1951	F	69.4	1	-	-	1	1	15	Mild	Yes	Yes
3861J	CWRU	11/18/2020	5/26/1952	M	68.5	4	4	-	-	-	40	Moderate	No	Yes
3952T	CWRU	12/9/2020	11/4/1983	F	37.1	1	-	-	-	-	5	Mild	No	No
4447AA	CWRU	12/11/2020	10/30/1989	M	31.1	3	2	2	-	-	35	Moderate	No	Yes
5338W	CWRU	10/26/2020	11/5/1967	F	53.0	1	1	1	-	-	15	Mild	Yes	No
5688U	CWRU	3/4/2021	4/18/2007	M	13.9	-	-	-	-	-	-	Zero	No	No
5933AA	CWRU	10/12/2020	6/5/1992	F	28.4	3	3	2	-	3	55	Severe	Yes	Yes
5937T	CWRU	1/7/2021	4/29/1987	F	33.7	2	-	1	3	-	30	Moderate	No	Yes
6073U	CWRU	2/17/2021	9/3/1956	M	64.5	-	-	-	-	-	-	Zero	No	No
6269V	CWRU	3/21/2021	5/20/1994	F	26.9	-	-	-	-	-	-	Zero	No	No
6457AA	CWRU	2/24/2021	8/9/2002	M	18.6	-	-	-	-	-	-	Zero	No	No
6864AA	CWRU	11/20/2020	10/12/1993	M	27.1	2	1	2	1	1	35	Moderate	No	Yes
6953AA	CWRU	3/28/2021	12/30/1992	F	28.3	-	-	-	-	-	-	Zero	No	No
7034V	CWRU	3/18/2021	6/7/1990	F	30.8	1	1	1	1	-	20	Mild	No	No
7530U	CWRU	10/23/2020	9/11/2003	M	17.1	-	-	-	-	-	-	Zero	No	No
8130V	CWRU	2/22/2021	7/23/1993	F	27.6	1	1	1	2	-	25	Mild	No	No
9267T	CWRU	4/7/2021	3/23/2004	F	17.1	1	1	2	1	1	30	Moderate	No	No
9606R	CWRU	10/27/2020	4/22/1991	F	29.5	-	-	-	-	-	-	Zero	No	No
9768U	CWRU	3/1/2021	9/3/1973	M	47.5	-	-	-	1	-	5	Mild	Yes	No
9868S	CWRU	4/20/2021	6/23/2008	F	12.8	1	-	-	1	-	10	Mild	No	Yes
AA12731	CWRU	2/17/2021	9/13/1990	F	30.5	-	-	-	-	-	-	Zero	No	No
AA12919	CWRU	1/12/2021	6/12/1995	F	25.6	-	-	-	-	-	-	Zero	No	No
AA13818	CWRU	10/9/2020	5/11/2005	F	15.4	-	-	-	-	-	-	Zero	No	No
AA16387	CWRU	2/27/2020	2/3/1958	M	62.1	1	-	-	-	-	5	Mild	Yes	No
AA16524	CWRU	2/23/2021	1/12/2009	F	12.1	1	-	-	-	-	5	Mild	No	No
AA17325	CWRU	2/15/2021	2/15/2007	F	14.0	-	-	-	-	-	-	Zero	No	No
AA17465	CWRU	3/15/2021	6/24/2007	M	13.7	-	-	-	1	-	5	Mild	No	No
AA18925	CWRU	2/24/2021	11/19/1982	F	38.3	-	-	-	-	-	-	Zero	No	No
AA19280	CWRU	9/23/2020	12/10/2006	F	13.8	1	-	-	-	-	5	Mild	No	No
AA19307	CWRU	3/8/2021	6/2/2004	F	16.8	-	-	-	-	-	-	Zero	No	No
AA19380	CWRU	9/9/2020	6/18/2008	M	12.2	1	1	-	-	-	10	Mild	No	Yes
AA19383	CWRU	3/29/2021	5/31/1995	F	25.8	-	-	-	-	-	-	Zero	No	No
AA19473	CWRU	1/11/2021	9/5/1996	F	24.4	1	-	-	-	-	5	Mild	No	Yes
AA19846	CWRU	1/15/2021	2/5/2002	M	19.0	-	-	-	1	1	10	Mild	No	No
AA21464	CWRU	2/16/2021	7/23/2006	F	14.6	-	-	-	-	-	-	Zero	No	Yes
AA21579	CWRU	12/30/2020	9/4/2007	F	13.3	1	-	-	-	-	5	Mild	No	No
AA21838	CWRU	11/18/2020	4/30/2007	F	13.6	-	-	-	-	-	-	Zero	No	No
AA22139	CWRU	2/25/2021	4/21/1997	F	23.9	-	-	-	-	-	-	Zero	No	Yes
AA22427	CWRU	10/7/2020	7/23/1997	F	23.2	1	-	2	-	-	15	Mild	No	No
AA23004	CWRU	12/3/2020	12/26/1996	F	24.0	-	-	-	1	-	5	Mild	No	Yes
AA23220	CWRU	2/18/2021	3/18/2008	F	12.9	-	-	-	-	-	-	Zero	No	No
AA23221	CWRU	2/18/2021	5/23/2010	M	10.8	-	-	-	-	-	-	Zero	No	No
AA23262	CWRU	11/9/2020	7/26/2008	M	12.3	2	2	3	1	1	45	Moderate	No	Yes
AA23267	CWRU	4/12/2021	1/18/1956	M	65.3	-	-	-	-	-	-	Zero	Yes	No
AA24113	CWRU	3/31/2021	2/2/1998	M	23.2	1	1	-	-	-	10	Mild	Yes	No
AA24417	CWRU	2/16/2021	10/18/1995	F	25.4	-	-	-	-	-	-	Zero	No	Yes
AA25224	CWRU	4/8/2021	4/23/1990	F	31.0	1	1	2	2	2	40	Moderate	No	No
AA25404	CWRU	2/25/2020	8/8/1988	F	31.6	1	-	-	-	2	15	Mild	No	Yes
AA25650	CWRU	11/9/2020	6/6/2006	M	14.4	-	-	-	-	-	-	Zero	No	No
AA26764	CWRU	3/9/2020	7/31/1999	M	20.6	1	-	-	-	-	5	Mild	Yes	No
AA26854	CWRU	3/25/2021	10/11/1982	M	38.5	-	-	-	-	-	-	Zero	No	No
AA26915	CWRU	2/17/2021	10/12/1996	M	24.4	-	-	1	-	-	5	Mild	No	No
AA26936	CWRU	11/20/2020	6/24/1997	F	23.4	-	-	-	-	-	-	Zero	No	No
AA27340	CWRU	2/9/2021	9/22/1994	M	26.4	-	-	-	-	-	-	Zero	No	No
AA27517	CWRU	3/2/2020	11/2/2006	M	13.3	-	-	-	-	-	-	Zero	No	No
AA27578	CWRU	2/14/2021	5/4/1995	M	25.8	1	1	1	1	2	30	Moderate	Yes	No
AA27580	CWRU	11/9/2020	11/25/1995	M	25.0	-	-	-	-	-	-	Zero	No	No
AA27629	CWRU	10/9/2020	5/15/2006	F	14.4	-	-	-	-	-	-	Zero	No	No
AA27642	CWRU	4/1/2021	2/26/1994	F	27.1	-	-	-	-	-	-	Zero	No	Yes
AA28405	CWRU	10/22/2020	8/4/2006	F	14.2	-	-	-	-	-	-	Zero	No	Yes
AA29240	CWRU	3/5/2021	9/12/1954	F	66.5	1	-	-	2	-	15	Mild	No	Yes
AA30131	CWRU	2/22/2021	3/6/1974	F	47.0	-	-	-	-	-	-	Zero	No	No
AA30169	CWRU	2/25/2021	7/10/1988	F	32.7	-	-	-	-	-	-	Zero	No	No
AA30344	CWRU	1/26/2021	4/4/2005	M	15.8	-	-	-	-	-	-	Zero	No	No
AA305	CWRU	3/15/2021	2/27/2008	F	13.1	-	-	-	-	-	-	Zero	No	No
AA30526	CWRU	3/29/2021	12/17/1964	F	56.3	-	-	-	-	-	-	Zero	No	No
AA30643	CWRU	1/25/2021	3/3/2007	M	13.9	3	3	3	1	1	55	Severe	No	Yes
AA30644	CWRU	1/25/2021	3/3/2007	M	13.9	3	3	3	1	1	55	Severe	No	Yes
AA30655	CWRU	3/31/2021	4/29/1990	F	30.9	-	-	-	-	-	-	Zero	No	No
AA3074	CWRU	10/21/2020	7/18/2007	F	13.3	-	-	-	-	-	-	Zero	No	No
AA31021	CWRU	11/9/2020	1/19/1996	F	24.8	-	-	-	-	-	-	Zero	No	Yes
AA31035	CWRU	3/8/2021	5/20/2002	F	18.8	-	-	-	-	-	-	Zero	No	No
AA31451	CWRU	2/27/2020	4/24/1985	F	34.9	-	-	-	-	-	-	Zero	No	No
AA32017	CWRU	12/14/2020	12/16/1948	F	72.0	-	-	-	-	-	-	Zero	Yes	No
AA32457	CWRU	1/20/2021	3/1/2008	M	12.9	-	-	-	-	-	-	Zero	No	No
AA32979	CWRU	3/1/2021	5/6/2005	F	15.8	-	-	-	-	-	-	Zero	No	No
AA3357	CWRU	12/14/2020	1/13/2007	F	13.9	-	-	-	-	-	-	Zero	No	No
AA34067	CWRU	4/5/2021	9/25/1992	F	28.5	2	-	2	-	3	35	Moderate	No	No
AA34512	CWRU	4/5/2021	8/5/2006	F	14.7	1	-	-	-	-	5	Mild	No	No
AA34964	CWRU	11/19/2020	3/8/2011	M	9.7	-	-	-	-	-	-	Zero	No	No
AA34993	CWRU	3/11/2020	6/12/2008	F	11.8	-	-	-	-	-	-	Zero	No	No
AA35257	CWRU	9/8/2020	4/17/2006	M	14.4	-	-	-	-	-	-	Zero	No	No
AA35684	CWRU	2/1/2021	12/8/2005	F	15.2	2	-	2	-	2	30	Moderate	No	Yes
AA35686	CWRU	2/1/2021	7/29/2008	M	12.5	-	-	-	2	-	10	Mild	No	No
AA35956	CWRU	3/22/2021	5/11/2004	M	16.9	-	-	-	-	-	-	Zero	No	No
AA3660	CWRU	2/24/2020	9/13/1995	M	24.5	-	-	-	-	-	-	Zero	No	No
AA36879	CWRU	1/6/2021	11/8/2007	F	13.2	2	3	3	-	-	40	Moderate	No	No

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						NOSE Score Data								
Patien	Location	Date of Scr	DoB	Gender	Age @ Scr	NOSE Scor	NOSE Scor	NOSE Scor	NOSE Scor	NOSE Scor	OSE Score	Severity	Trauma	Seas. Aller
AA36879	CWRU	1/6/2021	11/8/2007	F	13.2	2	3	3	-	-	40	Moderate	No	No
AA38146	CWRU	11/3/2020	4/3/2007	F	13.6	-	-	-	-	-	-	Zero	No	Yes
AA38732	CWRU	1/14/2021	12/26/1997	F	23.1	-	-	-	-	-	-	Zero	No	No
AA39100	CWRU	11/24/2020	10/12/2006	M	14.1	1	-	-	-	-	5	Mild	No	No
AA39309	CWRU	2/9/2021	10/6/2005	M	15.4	-	-	-	1	-	5	Mild	No	No
AA39326	CWRU	4/13/2021	1/29/2007	M	14.2	-	-	-	-	-	-	Zero	No	Yes
AA40238	CWRU	3/11/2021	4/12/2007	F	13.9	-	-	-	-	-	-	Zero	No	No
AA40711	CWRU	2/8/2021	11/6/2008	M	12.3	1	-	-	-	-	5	Mild	No	No
AA42046	CWRU	2/27/2020	12/30/2001	F	18.2	4	-	4	1	3	60	Severe	No	Yes
AA42252	CWRU	3/2/2020	5/11/2005	M	14.8	-	-	-	-	-	-	Zero	Yes	No
AA42336	CWRU	2/23/2021	9/28/2009	M	11.4	-	-	-	-	-	-	Zero	No	No
AA42579	CWRU	1/25/2021	4/24/1998	M	22.8	-	-	-	-	-	-	Zero	No	No
AA42748	CWRU	4/9/2021	2/19/1996	F	25.2	1	1	-	-	-	10	Mild	No	No
AA43122	CWRU	12/8/2020	8/2/2007	M	13.4	1	-	1	1	-	15	Mild	No	No
AA43308	CWRU	2/24/2020	7/24/1980	F	39.6	3	2	3	1	3	60	Severe	No	Yes
AA43326	CWRU	2/25/2020	9/11/2008	F	11.5	-	-	-	3	-	15	Mild	No	No
AA43357	CWRU	2/24/2020	9/11/1968	F	51.5	-	-	-	-	-	-	Zero	No	No
AA43371	CWRU	3/5/2020	5/5/2003	M	16.8	-	-	-	-	-	-	Zero	No	No
AA43372	CWRU	3/5/2020	3/2/2005	F	15.0	-	-	-	-	-	-	Zero	No	No
AA43544	CWRU	2/24/2020	8/6/1993	F	26.6	-	-	-	-	-	-	Zero	Yes	No
AA43626	CWRU	3/11/2020	6/16/2008	F	11.7	-	-	-	-	-	-	Zero	No	No
AA43724	CWRU	2/25/2020	12/19/2003	F	16.2	-	-	-	-	1	5	Mild	No	No
AA43729	CWRU	6/5/2020	5/14/2008	M	12.1	3	3	1	3	-	50	Moderate	No	Yes
AA43887	CWRU	2/24/2020	12/9/1997	M	22.2	1	1	1	1	-	20	Mild	No	No
AA43902	CWRU	10/23/2020	5/5/2004	F	16.5	-	-	-	-	-	-	Zero	No	No
AA43937	CWRU	3/5/2020	3/17/1999	F	21.0	-	-	-	-	-	-	Zero	No	No
AA44019	CWRU	3/11/2020	7/7/2008	M	11.7	-	-	-	-	-	-	Zero	No	No
AA44197	CWRU	10/23/2020	12/22/2004	M	15.8	-	-	-	-	-	-	Zero	No	No
AA44317	CWRU	3/2/2020	1/2/2008	M	12.2	-	-	-	-	-	-	Zero	No	No
AA44317	CWRU	4/1/2021	1/2/2008	M	13.3	1	-	-	-	-	5	Mild	No	No
AA44403	CWRU	2/24/2020	6/27/1988	F	31.7	-	-	-	-	-	-	Zero	No	No
AA44431	CWRU	2/27/2020	9/30/1994	F	25.4	-	-	2	1	1	20	Mild	No	No
AA44703	CWRU	11/16/2020	8/19/1993	M	27.3	-	-	-	-	1	5	Mild	No	No
AA44808	CWRU	2/27/2020	9/6/1993	F	26.5	-	-	-	-	-	-	Zero	No	No
AA44968	CWRU	10/26/2020	9/3/2008	F	12.2	-	-	-	1	-	5	Mild	No	Yes
AA45020	CWRU	10/29/2020	3/14/1968	F	52.7	3	1	2	-	1	35	Moderate	No	Yes
AA45104	CWRU	1/8/2021	3/20/2008	F	12.8	1	-	-	2	-	15	Mild	No	No
AA45431	CWRU	11/16/2020	1/3/1967	M	53.9	1	1	1	-	1	20	Mild	No	Yes
AA45490	CWRU	10/6/2020	12/20/2003	M	16.8	-	-	-	-	1	5	Mild	No	No
AA45571	CWRU	1/25/2021	12/6/1986	F	34.2	3	1	-	-	-	20	Mild	No	Yes
AA46160	CWRU	4/1/2021	12/2/1966	M	54.4	-	-	-	-	-	-	Zero	Yes	No
AA46234	CWRU	4/9/2021	3/6/1996	M	25.1	-	-	-	2	-	10	Mild	No	No
AA46498	CWRU	9/4/2020	10/27/2005	M	14.9	-	-	-	-	-	-	Zero	No	No
AA46678	CWRU	3/31/2021	5/16/1988	M	32.9	-	-	-	1	-	5	Mild	No	No
AA46708	CWRU	11/30/2020	9/21/1996	F	24.2	-	-	-	-	-	-	Zero	No	No
AA47281	CWRU	9/2/2020	7/29/2005	F	15.1	3	2	1	2	1	45	Moderate	No	Yes
AA47336	CWRU	9/11/2020	2/10/2007	F	13.6	-	-	-	-	-	-	Zero	No	No
AA47347	CWRU	9/9/2020	12/12/1994	F	25.8	2	2	1	-	2	35	Moderate	No	No
AA47359	CWRU	9/7/2020	4/12/1995	F	25.4	-	-	-	-	-	-	Zero	No	No
AA47367	CWRU	9/8/2020	8/20/2007	F	13.1	-	-	-	-	-	-	Zero	No	Yes
AA47379	CWRU	9/14/2020	5/24/2006	F	14.3	-	-	-	-	1	5	Mild	No	No
AA47394	CWRU	9/17/2020	1/8/2007	M	13.7	-	-	-	-	-	-	Zero	No	Yes
AA47417	CWRU	9/21/2020	4/12/2008	F	12.5	-	1	-	-	-	5	Mild	No	No
AA47419	CWRU	9/9/2020	2/12/2002	M	18.6	-	-	-	-	-	-	Zero	No	No
AA47456	CWRU	9/14/2020	8/21/2008	F	12.1	-	-	-	-	-	-	Zero	No	No
AA47477	CWRU	9/22/2020	1/9/2008	F	12.7	-	-	-	-	-	-	Zero	No	No
AA47478	CWRU	9/22/2020	11/14/2006	M	13.9	-	-	-	-	-	-	Zero	No	No
AA47490	CWRU	3/25/2021	1/2/2005	F	16.2	-	-	-	-	-	-	Zero	No	No
AA47569	CWRU	3/1/2021	12/28/1992	M	28.2	-	-	-	-	-	-	Zero	No	No
AA47570	CWRU	2/24/2021	12/15/2003	F	17.2	1	-	-	-	-	5	Mild	Yes	No
AA47584	CWRU	9/25/2020	9/6/2008	F	12.1	-	-	-	-	-	-	Zero	No	No
AA47651	CWRU	9/25/2020	4/25/2006	M	14.4	-	-	-	-	-	-	Zero	No	No
AA47714	CWRU	10/6/2020	11/29/2007	F	12.9	-	-	-	-	-	-	Zero	No	No
AA47907	CWRU	10/13/2020	3/10/1998	F	22.6	-	-	-	-	-	-	Zero	No	No
AA47967	CWRU	3/18/2021	11/14/2007	F	13.4	-	-	-	-	-	-	Zero	No	No
AA48057	CWRU	10/20/2020	9/26/2001	F	19.1	1	-	-	-	-	5	Mild	Yes	No
AA48070	CWRU	10/9/2020	7/25/2005	F	15.2	-	-	-	-	-	-	Zero	No	No
AA48105	CWRU	10/20/2020	12/29/2006	F	13.8	1	-	-	-	-	5	Mild	No	Yes
AA48137	CWRU	11/20/2020	12/30/1987	F	32.9	3	2	3	2	2	60	Severe	Yes	No
AA48381	CWRU	10/20/2020	9/17/2006	M	14.1	-	-	-	-	-	-	Zero	No	Yes
AA48429	CWRU	10/21/2020	4/11/2000	F	20.5	-	-	3	3	3	45	Moderate	No	No
AA48462	CWRU	10/14/2020	11/30/1989	F	30.9	-	-	-	-	-	-	Zero	No	No
AA48475	CWRU	10/27/2020	3/5/2009	F	11.7	1	-	1	-	-	10	Mild	No	No
AA48577	CWRU	11/24/2020	12/4/1980	F	40.0	-	-	-	-	-	-	Zero	No	No
AA48642	CWRU	11/2/2020	6/11/2001	F	19.4	-	-	-	-	-	-	Zero	No	No
AA48666	CWRU	10/30/2020	4/11/2006	M	14.6	1	-	-	-	-	5	Mild	No	No
AA48799	CWRU	11/10/2020	1/3/2006	M	14.9	-	-	-	-	-	-	Zero	No	Yes
AA48808	CWRU	11/20/2020	7/27/2007	M	13.3	-	-	-	-	-	-	Zero	No	No
AA48820	CWRU	12/1/2020	6/28/1996	F	24.4	-	-	-	-	-	-	Zero	No	No
AA48920	CWRU	1/25/2021	9/23/1992	F	28.4	-	-	-	-	-	-	Zero	No	No
AA48999	CWRU	11/24/2020	3/2/2004	M	16.7	1	1	1	-	1	20	Mild	No	Yes
AA49050	CWRU	1/28/2021	10/16/1997	F	23.3	1	1	-	-	-	10	Mild	No	No
AA49059	CWRU	11/30/2020	9/28/1997	F	23.2	-	-	-	-	-	-	Zero	No	No
AA49122	CWRU	11/10/2020	12/8/2003	F	16.9	-	-	-	-	-	-	Zero	No	No
AA49146	CWRU	11/20/2020	1/25/1989	F	31.8	1	-	-	-	1	10	Mild	No	No
AA49154	CWRU	11/23/2020	9/5/1984	M	36.2	2	1	1	2	2	40	Moderate	No	No
AA49260	CWRU	11/20/2020	5/29/2008	F	12.5	-	-	-	-	1	5	Mild	No	No
AA49293	CWRU	3/25/2021	8/7/1989	F	31.7	-	-	-	-	-	-	Zero	No	No
AA49374	CWRU	1/28/2021	7/14/1956	M	64.6	-	-	-	-	-	-	Zero	No	No
AA49392	CWRU	1/4/2021	8/5/1976	F	44.4	2	3	2	4	2	65	Severe	No	No
AA49406	CWRU	3/8/2021	8/13/1981	M	39.6	-	-	-	-	-	-	Zero	No	Yes
AA49435	CWRU	11/30/2020	7/13/1998	F	22.4	2	1	1	-	-	20	Mild	No	No
AA49436	CWRU	1/6/2021	2/26/1975	F	45.9	3	2	1	1	-	35	Moderate	No	Yes
AA49442	CWRU	11/17/2020	3/10/2006	F	14.7	-	-	-	-	-	-	Zero	No	No
AA49448	CWRU	11/24/2020	10/27/1986	F	34.1	-	-	-	-	-	-	Zero	No	No

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						NOSE Score Data								
Patien	Location	Date of Scr	DoB	Gender	Age @ Scr	NOSE Scor	NOSE Scor	NOSE Scor	NOSE Scor	NOSE Scor	OSE Score	Severity	Trauma	Seas. Aller
AA49448	CWRU	11/24/2020	10/27/1986	F	34.1	-	-	-	-	-	-	Zero	No	No
AA49456	CWRU	11/16/2020	3/3/2008	F	12.7	1	-	-	-	-	5	Mild	No	Yes
AA49485	CWRU	11/19/2020	2/28/2005	F	15.7	1	-	-	-	-	5	Mild	No	No
AA49488	CWRU	12/18/2020	11/19/2000	F	20.1	-	-	-	-	-	-	Zero	No	No
AA49508	CWRU	11/17/2020	1/29/1988	F	32.8	1	1	1	-	1	20	Mild	No	No
AA49609	CWRU	1/12/2021	4/12/2003	F	17.8	-	-	-	-	-	-	Zero	No	Yes
AA49611	CWRU	1/12/2021	8/22/2005	M	15.4	-	-	-	-	-	-	Zero	No	No
AA49672	CWRU	1/25/2021	11/11/2008	M	12.2	-	-	-	-	-	-	Zero	No	Yes
AA49776	CWRU	1/6/2021	10/5/2007	F	13.3	-	-	-	-	-	-	Zero	No	No
AA49998	CWRU	1/28/2021	9/19/1990	F	30.4	-	-	-	1	-	5	Mild	No	No
AA50026	CWRU	1/20/2021	11/11/2007	M	13.2	-	1	-	-	-	5	Mild	No	No
AA50034	CWRU	3/8/2021	4/5/1988	F	32.9	-	-	-	-	-	-	Zero	No	No
AA50088	CWRU	3/29/2021	10/10/1999	F	21.5	-	-	-	-	-	-	Zero	No	No
AA50125	CWRU	1/25/2021	12/14/1986	F	34.1	-	-	-	-	-	-	Zero	Yes	No
AA50133	CWRU	2/17/2021	10/23/1984	F	36.3	-	-	-	-	-	-	Zero	No	Yes
AA50144	CWRU	2/15/2021	2/11/1995	F	26.0	-	-	-	-	-	-	Zero	No	No
AA50213	CWRU	2/8/2021	7/22/1992	M	28.6	-	-	-	-	-	-	Zero	No	No
AA50315	CWRU	1/24/2021	2/21/2006	F	14.9	-	-	-	-	-	-	Zero	No	No
AA50401	CWRU	1/27/2021	2/15/1999	F	22.0	-	-	-	-	-	-	Zero	No	Yes
AA50425	CWRU	3/4/2021	12/15/1969	M	51.3	-	-	-	-	-	-	Zero	No	No
AA50557	CWRU	1/12/2021	7/1/1991	F	29.6	3	-	3	3	3	60	Severe	No	No
AA50601	CWRU	1/13/2021	11/11/1998	F	22.2	-	-	-	-	-	-	Zero	No	No
AA50606	CWRU	3/25/2021	7/20/1985	F	35.7	-	-	-	-	-	-	Zero	No	No
AA50646	CWRU	1/27/2021	3/3/1999	F	21.9	-	-	-	-	-	-	Zero	No	No
AA50647	CWRU	1/25/2021	7/25/1984	M	36.5	-	-	-	-	-	-	Zero	No	Yes
AA50656	CWRU	3/15/2021	4/10/1987	F	34.0	-	-	-	-	-	-	Zero	No	No
AA50657	CWRU	2/2/2021	1/30/2007	F	14.0	-	-	-	-	-	-	Zero	No	No
AA50658	CWRU	2/2/2021	5/24/2008	F	12.7	-	-	-	-	-	-	Zero	No	No
AA50677	CWRU	1/26/2021	2/27/2008	M	12.9	-	-	-	-	-	-	Zero	No	No
AA50679	CWRU	1/26/2021	8/30/2006	M	14.4	-	-	-	-	-	-	Zero	No	No
AA50740	CWRU	2/1/2021	9/4/1991	F	29.4	1	1	1	1	1	25	Mild	No	No
AA50768	CWRU	1/28/2021	10/22/2003	F	17.3	-	-	-	-	-	-	Zero	No	No
AA50771	CWRU	2/1/2021	3/24/1966	M	54.9	1	-	-	-	-	5	Mild	No	No
AA50791	CWRU	3/18/2021	3/14/1978	F	43.0	-	-	-	-	-	-	Zero	No	No
AA50819	CWRU	2/9/2020	12/10/2001	F	18.2	-	-	-	-	-	-	Zero	No	No
AA50883	CWRU	1/20/2021	7/1/2004	F	16.6	-	-	-	-	-	-	Zero	No	No
AA50923	CWRU	2/25/2021	4/21/1982	F	38.9	-	-	-	1	2	15	Mild	No	No
AA51073	CWRU	3/25/2021	7/1/1999	M	21.7	3	3	3	1	2	60	Severe	No	No
AA51075	CWRU	2/1/2021	9/12/1994	F	26.4	-	-	-	-	-	-	Zero	No	No
AA51150	CWRU	3/31/2021	1/24/1990	M	31.2	-	-	-	-	-	-	Zero	No	No
AA51189	CWRU	2/23/2021	12/20/2003	M	17.2	-	-	-	1	-	5	Mild	No	No
AA51207	CWRU	1/28/2021	6/23/1994	M	26.6	-	-	-	-	-	-	Zero	No	No
AA51239	CWRU	2/17/2021	11/20/2006	F	14.3	-	-	-	1	-	5	Mild	No	No
AA51262	CWRU	2/10/2021	7/8/1986	F	34.6	-	-	-	-	-	-	Zero	No	No
AA51272	CWRU	3/31/2021	8/12/2004	M	16.6	-	-	-	-	-	-	Zero	No	No
AA51301	CWRU	2/9/2021	5/19/2002	F	18.7	-	-	1	-	-	5	Mild	No	No
AA51315	CWRU	1/27/2021	3/28/1951	M	69.9	-	-	1	1	-	10	Mild	No	No
AA51362	CWRU	2/1/2021	8/29/2008	F	12.4	-	-	-	-	-	-	Zero	No	No
AA51387	CWRU	2/10/2021	2/7/2007	F	14.0	1	-	-	-	-	5	Mild	No	No
AA51509	CWRU	3/24/2021	12/9/2006	M	14.3	-	-	-	-	-	-	Zero	No	No
AA51515	CWRU	2/10/2021	12/5/1980	F	40.2	-	-	-	-	2	10	Mild	No	No
AA51524	CWRU	1/28/2021	7/8/1989	F	31.6	-	-	-	-	-	-	Zero	No	No
AA51536	CWRU	2/22/2021	7/5/2006	F	14.6	-	-	-	-	-	-	Zero	No	No
AA51538	CWRU	2/8/2021	3/31/1993	F	27.9	-	-	-	2	-	10	Mild	Yes	No
AA51564	CWRU	2/17/2021	11/24/1973	F	47.3	3	1	2	1	-	35	Moderate	No	Yes
AA51565	CWRU	3/29/2021	2/27/1991	M	30.1	-	-	-	-	-	-	Zero	No	No
AA51590	CWRU	2/11/2021	12/18/2006	F	14.2	-	-	-	1	1	10	Mild	No	No
AA51704	CWRU	2/15/2021	8/6/2006	F	14.5	-	-	-	-	-	-	Zero	No	No
AA51705	CWRU	3/1/2021	1/7/2004	M	17.2	-	-	-	-	-	-	Zero	No	No
AA51708	CWRU	3/2/2021	5/8/2007	F	13.8	-	-	-	-	-	-	Zero	No	No
AA51744	CWRU	3/3/2021	3/10/2006	F	15.0	-	-	-	-	-	-	Zero	No	No
AA51758	CWRU	4/9/2021	7/5/1972	F	48.8	1	-	-	-	-	5	Mild	No	No
AA51793	CWRU	4/5/2021	1/6/2009	M	12.3	3	2	1	1	-	35	Moderate	No	Yes
AA51794	CWRU	4/5/2021	1/16/1979	F	42.2	-	-	-	-	-	-	Zero	No	No
AA51816	CWRU	2/23/2021	1/9/2008	F	13.1	1	-	-	-	-	5	Mild	No	No
AA51875	CWRU	2/17/2021	1/30/1989	F	32.1	-	-	-	-	-	-	Zero	Yes	No
AA51892	CWRU	2/17/2021	5/4/2005	M	15.8	1	-	-	-	-	5	Mild	No	No
AA51918	CWRU	2/22/2021	10/21/2007	M	13.4	-	-	-	-	-	-	Zero	No	No
AA51941	CWRU	2/23/2021	8/17/2007	F	13.5	-	-	-	-	-	-	Zero	No	No
AA51973	CWRU	3/1/2021	7/26/2005	M	15.6	-	-	-	-	-	-	Zero	No	No
AA52005	CWRU	2/15/2021	12/7/2002	M	18.2	1	-	-	1	-	10	Mild	No	No
AA52023	CWRU	2/11/2021	5/3/2009	F	11.8	-	-	-	-	-	-	Zero	No	No
AA52028	CWRU	2/17/2021	10/20/1994	F	26.3	-	-	-	-	-	-	Zero	No	No
AA52047	CWRU	2/15/2021	6/16/2000	M	20.7	-	-	-	-	-	-	Zero	No	Yes
AA52058	CWRU	3/8/2021	10/25/2005	M	15.4	2	2	2	1	2	45	Moderate	No	No
AA52069	CWRU	2/25/2021	9/15/2010	F	10.5	-	-	-	-	-	-	Zero	No	No
AA52131	CWRU	3/8/2021	12/10/2005	F	15.3	1	-	-	-	-	5	Mild	No	No
AA52177	CWRU	3/15/2021	10/30/1992	M	28.4	1	-	1	2	1	25	Mild	No	Yes
AA52252	CWRU	2/24/2021	6/1/2000	F	20.7	1	-	-	-	-	5	Mild	No	No
AA52299	CWRU	4/19/2021	2/15/2007	F	14.2	2	1	2	4	4	65	Severe	Yes	No
AA52344	CWRU	3/2/2021	4/19/2010	F	10.9	-	-	-	-	-	-	Zero	No	No
AA52366	CWRU	3/2/2021	6/12/1970	F	50.8	-	-	-	-	-	-	Zero	No	No
AA52372	CWRU	4/12/2021	2/25/1982	F	39.2	-	-	-	-	-	-	Zero	No	No
AA52630	CWRU	3/5/2021	12/21/2007	M	13.2	-	-	-	-	-	-	Zero	No	No
AA52631	CWRU	3/5/2021	12/21/2007	F	13.2	-	-	-	-	-	-	Zero	No	No
AA52649	CWRU	3/9/2021	12/17/2007	M	13.2	-	-	-	-	-	-	Zero	No	No
AA52680	CWRU	3/9/2021	12/18/2006	F	14.2	-	-	-	-	-	-	Zero	No	No
AA52693	CWRU	3/10/2021	10/27/1998	F	22.4	-	-	-	1	-	5	Mild	No	No
AA52736	CWRU	3/11/2021	11/10/2004	M	16.3	-	-	-	-	-	-	Zero	No	No
AA52762	CWRU	3/18/2021	5/30/2007	F	13.8	1	-	-	-	-	5	Mild	Yes	No
AA52764	CWRU	3/18/2021	4/2/2008	M	13.0	-	-	-	1	1	10	Mild	No	No
AA52804	CWRU	3/18/2021	8/13/1996	M	24.6	-	-	-	-	-	-	Zero	No	No
AA52914	CWRU	4/21/2021	10/29/2007	F	13.5	-	-	-	2	-	10	Mild	No	No
AA53013	CWRU	3/15/2021	9/9/2008	F	12.5	1	-	-	-	-	5	Mild	No	No
AA53026	CWRU	3/31/2021	9/16/2007	M	13.5	1	1	1	2	-	25	Mild	No	No
AA53096	CWRU	3/31/2021	10/25/1993	M	27.4	2	1	1	2	3	45	Moderate	No	No

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						NOSE Score Data								
Patien	Location	Date of Scr	DoB	Gender	Age @ Scr	NOSE Scor	NOSE Scor	NOSE Scor	NOSE Scor	NOSE Scor	OSE Score	Severity	Trauma	Seas. Aller
AA53184	CWRU	3/27/2021	4/17/1969	M	52.0	-	-	-	-	2	10	Mild	No	No
AA53220	CWRU	3/24/2021	5/6/1990	F	30.9	-	-	-	-	-	-	Zero	No	Yes
AA53255	CWRU	3/18/2021	6/9/1998	M	22.8	1	1	-	-	-	10	Mild	No	No
AA53297	CWRU	4/19/2021	1/17/2005	M	16.3	-	-	-	-	-	-	Zero	No	No
AA53445	CWRU	4/20/2021	6/1/2005	M	15.9	-	-	-	-	-	-	Zero	No	No
AA53479	CWRU	3/24/2021	10/2/2010	M	10.5	-	-	-	-	-	-	Zero	No	No
AA53532	CWRU	4/7/2021	8/18/2006	F	14.6	-	-	-	-	-	-	Zero	No	No
AA53619	CWRU	4/7/2021	11/21/2007	M	13.4	-	-	-	-	-	-	Zero	No	No
AA53674	CWRU	4/19/2021	8/31/2008	F	12.6	-	-	-	-	-	-	Zero	No	No
AA53720	CWRU	4/8/2021	4/28/2005	F	16.0	1	1	-	-	-	10	Mild	No	No
AA53726	CWRU	3/6/2021	3/1/2009	M	12.0	-	-	-	-	-	-	Zero	No	No
AA53741	CWRU	3/31/2021	3/11/1971	M	50.1	-	-	-	-	-	-	Zero	No	No
AA53759	CWRU	4/5/2021	4/22/1987	M	34.0	-	-	-	-	1	5	Mild	No	No
AA53769	CWRU	4/5/2021	2/24/2006	F	15.1	-	-	-	-	-	-	Zero	No	No
AA53771	CWRU	4/5/2021	12/2/2007	F	13.4	-	-	-	-	-	-	Zero	No	No
AA53852	CWRU	4/12/2021	1/24/2008	F	13.2	-	-	-	-	-	-	Zero	No	No
AA53911	CWRU	4/12/2021	8/10/2006	F	14.7	1	1	1	-	1	20	Mild	No	No
AA53928	CWRU	4/12/2021	11/11/2010	M	10.4	-	-	-	-	-	-	Zero	No	No
AA54001	CWRU	4/15/2021	11/15/2004	M	16.4	-	-	-	-	-	-	Zero	No	No
AA54080	CWRU	4/19/2021	7/8/2006	M	14.8	-	-	-	-	-	-	Zero	No	No
AA54192	CWRU	4/19/2021	5/17/2002	F	18.9	-	-	-	-	-	-	Zero	No	No
AA6312	CWRU	3/18/2021	10/25/1991	M	29.4	-	-	-	-	-	-	Zero	No	Yes
AA6369	CWRU	3/23/2021	9/26/1976	F	44.5	-	-	-	-	-	-	Zero	No	No
AA6648	CWRU	2/2/2021	8/19/2000	M	20.5	-	-	1	3	1	25	Mild	No	No
AA7277	CWRU	9/25/2020	2/21/2009	F	11.6	1	-	-	3	-	20	Mild	No	Yes
AA7404	CWRU	12/11/2020	10/28/1985	F	35.1	-	-	-	-	-	-	Zero	No	No
AA757	CWRU	4/12/2021	10/28/2008	F	12.5	-	-	-	-	-	-	Zero	No	No
AA7605	CWRU	9/8/2020	2/2/1991	F	29.6	2	1	1	1	1	30	Moderate	No	No
AA8462	CWRU	4/19/2021	12/10/2007	M	13.4	2	1	-	-	-	15	Mild	Yes	No
C1	Corporate	4/16/2021	11/15/2008	F	12.4	-	-	-	-	-	-	Zero	No	No
C10	Corporate	4/10/2021	10/11/2005	F	15.5	-	-	-	-	-	-	Zero	No	No
C11	Corporate	4/10/2021	1/14/1991	F	30.3	-	-	-	-	-	-	Zero	No	No
C12	Corporate	4/9/2021	5/21/1999	F	21.9	-	-	-	-	-	-	Zero	No	No
C13	Corporate	4/9/2021	8/2/2003	F	17.7	-	-	-	-	-	-	Zero	No	No
C14	Corporate	4/9/2021	6/3/2008	F	12.9	-	-	-	-	-	-	Zero	No	No
C15	Corporate	3/19/2021	4/24/1981	F	39.9	-	-	-	-	-	-	Zero	No	No
C16	Corporate	3/23/2021	3/2/1993	M	28.1	-	-	-	-	-	-	Zero	No	No
C17	Corporate	4/10/2021	1/16/2008	F	13.2	-	-	-	-	-	-	Zero	No	No
C18	Corporate	4/17/2021	4/18/2002	F	19.0	-	-	-	-	-	-	Zero	No	No
C19	Corporate	4/17/2021	2/28/2008	F	13.1	-	-	-	-	-	-	Zero	No	No
C2	Corporate	4/19/2021	1/3/2003	M	18.3	-	-	-	-	-	-	Zero	No	No
C20	Corporate	4/17/2021	2/28/2008	F	13.1	-	-	-	-	-	-	Zero	No	No
C21	Corporate	4/17/2021	3/3/2010	M	11.1	-	-	-	-	-	-	Zero	No	No
C22	Corporate	4/17/2021	12/4/1985	F	35.4	-	-	-	-	-	-	Zero	No	No
C23	Corporate	4/17/2021	7/17/1982	F	38.8	-	-	-	-	-	-	Zero	No	No
C24	Corporate	4/16/2021	9/9/1997	F	23.6	-	-	-	-	-	-	Zero	No	No
C25	Corporate	4/16/2021	6/23/1969	F	51.8	-	-	-	-	-	-	Zero	No	No
C26	Corporate	4/16/2021	11/25/2008	F	12.4	-	-	-	-	-	-	Zero	No	No
C27	Corporate	4/16/2021	8/26/2003	F	17.7	-	-	-	-	-	-	Zero	No	No
C28	Corporate	4/14/2021	8/19/2001	M	19.7	-	-	-	-	-	-	Zero	No	No
C29	Corporate	4/19/2021	4/23/1992	F	29.0	-	-	-	-	-	-	Zero	No	No
C3	Corporate	4/19/2021	6/16/1997	M	23.9	-	-	-	-	-	-	Zero	No	No
C30	Corporate	4/19/2021	1/9/2004	M	17.3	-	-	-	-	-	-	Zero	No	No
C31	Corporate	4/19/2021	11/16/2002	F	18.4	4	-	2	3	2	55	Severe	No	Yes
C32	Corporate	4/19/2021	3/8/2007	M	14.1	-	-	-	2	-	10	Mild	No	No
C33	Corporate	4/19/2021	5/31/2001	F	19.9	-	1	-	-	-	5	Mild	No	No
C34	Corporate	4/16/2021	12/31/2006	M	14.3	2	2	2	-	-	30	Moderate	No	No
C35	Corporate	4/14/2021	1/23/2006	F	15.2	-	-	-	4	-	20	Mild	No	No
C36	Corporate	4/16/2021	8/14/1970	F	50.7	-	-	-	2	1	15	Mild	No	No
C37	Corporate	4/16/2021	2/4/2006	F	15.2	-	-	1	-	-	5	Mild	No	No
C38	Corporate	4/17/2021	8/11/2007	F	13.7	-	-	1	3	-	20	Mild	No	No
C39	Corporate	4/17/2021	9/3/1985	F	35.6	1	-	1	1	-	15	Mild	No	Yes
C4	Corporate	4/8/2021	3/1/2007	M	14.1	-	-	-	-	-	-	Zero	No	No
C40	Corporate	4/17/2021	3/24/1982	F	39.1	1	-	-	2	1	20	Mild	No	No
C41	Corporate	4/17/2021	12/4/1985	M	35.4	1	-	-	-	-	5	Mild	No	Yes
C42	Corporate	4/17/2021	10/27/2008	F	12.5	1	-	1	-	-	10	Mild	No	No
C43	Corporate	4/17/2021	1/9/1989	F	32.3	2	1	2	3	1	45	Moderate	No	No
C44	Corporate	4/17/2021	6/15/2001	M	19.9	1	-	-	-	-	5	Mild	No	No
C45	Corporate	4/10/2021	12/5/2009	F	11.4	-	-	2	-	1	15	Mild	No	No
C46	Corporate	3/19/2021	2/4/2013	M	8.1	1	-	-	-	-	5	Mild	No	No
C47	Corporate	4/8/2021	2/21/2011	M	10.1	1	-	-	-	-	5	Mild	No	No
C48	Corporate	4/8/2021	4/13/1992	F	29.0	1	-	-	-	-	5	Mild	No	Yes
C49	Corporate	4/8/2021	8/1/2013	F	7.7	-	-	-	2	-	10	Mild	No	No
C5	Corporate	4/10/2021	5/29/1994	F	26.9	-	-	-	-	-	-	Zero	No	No
C50	Corporate	4/8/2021	2/15/1956	M	65.2	1	1	-	-	1	15	Mild	No	No
C51	Corporate	4/8/2021	11/7/2010	M	10.4	1	-	-	-	-	5	Mild	No	No
C52	Corporate	4/8/2021	5/14/2002	M	18.9	1	1	-	-	-	10	Mild	No	No
C53	Corporate	4/8/2021	7/20/2006	F	14.7	-	-	-	-	1	5	Mild	No	No
C54	Corporate	4/9/2021	11/29/2003	M	17.4	-	-	-	-	1	5	Mild	No	No
C55	Corporate	4/8/2021	6/1/2004	M	16.9	2	2	-	-	2	30	Moderate	No	Yes
C56	Corporate	4/9/2021	9/16/1998	F	22.6	1	-	-	-	-	5	Mild	No	No
C57	Corporate	4/9/2021	9/10/2004	M	16.6	1	2	2	-	-	25	Mild	No	No
C58	Corporate	4/10/2021	7/12/2004	F	16.8	-	-	-	1	-	5	Mild	No	No
C59	Corporate	4/9/2021	2/4/2006	M	15.2	1	-	-	-	-	5	Mild	No	No
C6	Corporate	4/10/2021	7/24/1995	F	25.7	-	-	-	-	-	-	Zero	No	No
C60	Corporate	4/10/2021	2/20/2007	F	14.1	-	-	-	1	-	5	Mild	No	No
C61	Corporate	4/10/2021	9/23/1994	F	26.6	2	1	2	1	1	35	Moderate	No	No
C7	Corporate	4/10/2021	1/19/1993	F	28.2	-	-	-	-	-	-	Zero	No	No
C8	Corporate	4/10/2021	2/15/2008	M	13.2	-	-	-	-	-	-	Zero	No	No
C9	Corporate	4/9/2021	12/2/2004	F	16.4	-	-	-	-	-	-	Zero	No	No
T117440	CWRU	3/2/2020	11/7/1985	M	34.3	3	3	3	-	1	50	Moderate	Yes	No
TE1	Private Practice	4/2/2021	11/30/1988	F	32.4	-	-	-	-	-	-	Zero	No	No
TE10	Private Practice	3/30/2021	2/16/2014	M	7.1	-	-	-	-	-	-	Zero	No	No
TE11	Private Practice	3/30/2021	7/3/2012	M	8.7	-	-	-	-	-	-	Zero	No	No
TE12	Private Practice	3/30/2021	10/26/2008	F	12.4	-	-	-	-	-	-	Zero	No	No
TE13	Private Practice	3/16/2021	1/16/2009	F	12.2	-	-	-	-	-	-	Zero	No	No

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						NOSE Score Data								
Patien	Location	Date of Scr	DoB	Gender	Age @ Scr	NOSE Scor	NOSE Scor	NOSE Scor	NOSE Scor	NOSE Scor	OSE Score	Severity	Trauma	Seas. Aller
TE14	Private Practice	3/22/2021	8/22/2009	F	11.6	-	-	-	-	-	-	Zero	No	No
TE15	Private Practice	3/16/2021	4/7/2009	M	11.9	-	-	-	-	-	-	Zero	No	No
TE16	Private Practice	3/16/2021	11/1/2004	F	16.4	-	-	-	-	-	-	Zero	No	No
TE17	Private Practice	3/16/2021	10/11/2005	F	15.4	-	-	-	-	-	-	Zero	No	No
TE18	Private Practice	3/16/2021	7/1/2009	F	11.7	-	-	-	-	-	-	Zero	No	No
TE19	Private Practice	3/16/2021	1/28/2011	F	10.1	1	-	-	-	-	5	Mild	No	No
TE2	Private Practice	3/26/2021	6/19/1979	M	41.8	-	-	-	-	-	-	Zero	No	No
TE20	Private Practice	2/26/2021	9/11/2005	F	15.5	-	-	-	-	-	-	Zero	No	No
TE21	Private Practice	2/26/2021	12/12/2007	F	13.2	-	-	-	-	-	-	Zero	No	No
TE22	Private Practice	3/1/2021	9/7/2000	M	20.5	-	-	-	-	-	-	Zero	No	No
TE23	Private Practice	3/12/2021	7/11/1962	M	58.7	-	-	-	-	-	-	Zero	No	No
TE24	Private Practice	3/12/2021	5/14/2008	F	12.8	-	-	-	-	-	-	Zero	No	No
TE25	Private Practice	4/13/2021	2/4/1980	F	41.2	-	-	-	-	-	-	Zero	No	Yes
TE26	Private Practice	3/16/2021	10/16/2010	M	10.4	-	-	-	-	-	-	Zero	No	No
TE27	Private Practice	4/2/2021	11/7/2006	M	14.4	1	-	-	2	-	15	Mild	No	No
TE28	Private Practice	3/26/2021	6/27/2008	M	12.8	4	4	4	-	4	80	Extreme	No	Yes
TE29	Private Practice	3/26/2021	6/21/2006	F	14.8	-	1	-	2	1	20	Mild	No	No
TE3	Private Practice	3/30/2021	6/19/2008	F	12.8	-	-	-	-	-	-	Zero	No	No
TE30	Private Practice	3/30/2021	3/18/2012	M	9.0	2	1	1	1	-	25	Mild	No	No
TE31	Private Practice	4/3/2021	3/7/2005	F	16.1	-	3	2	2	1	40	Moderate	No	No
TE32	Private Practice	4/3/2021	8/20/2008	M	12.6	-	-	-	1	-	5	Mild	No	Yes
TE33	Private Practice	4/5/2021	2/1/2008	M	13.2	1	-	-	-	-	5	Mild	No	No
TE34	Private Practice	3/30/2021	6/2/2012	F	8.8	2	2	2	2	2	50	Moderate	No	No
TE35	Private Practice	3/30/2021	1/26/2008	F	13.2	1	-	-	-	-	5	Mild	No	Yes
TE36	Private Practice	3/30/2021	2/7/2007	M	14.2	2	-	1	3	2	40	Moderate	No	No
TE37	Private Practice	3/22/2021	12/16/2007	M	13.3	2	2	2	2	2	50	Moderate	No	No
TE38	Private Practice	3/22/2021	5/11/1996	M	24.9	2	1	1	3	3	50	Moderate	No	Yes
TE39	Private Practice	3/12/2021	12/31/2008	F	12.2	1	1	1	-	-	15	Mild	No	No
TE4	Private Practice	3/30/2021	10/28/2010	F	10.4	-	-	-	-	-	-	Zero	No	No
TE40	Private Practice	3/26/2021	4/6/1988	F	33.0	3	-	1	2	1	35	Moderate	No	Yes
TE41	Private Practice	3/13/2021	8/17/2003	M	17.6	1	2	2	-	1	30	Moderate	No	No
TE42	Private Practice	2/26/2021	4/7/2009	M	11.9	1	1	-	-	-	10	Mild	No	No
TE43	Private Practice	2/26/2021	5/10/2010	M	10.8	-	-	-	2	-	10	Mild	No	No
TE44	Private Practice	3/12/2021	8/3/2009	F	11.6	1	-	-	2	1	20	Mild	No	No
TE45	Private Practice	3/12/2021	2/6/2012	M	9.1	-	-	-	1	-	5	Mild	No	No
TE46	Private Practice	3/12/2021	2/3/1986	F	35.1	1	-	-	-	-	5	Mild	No	Yes
TE47	Private Practice	3/12/2021	6/6/2007	F	13.8	2	-	1	-	2	25	Mild	Yes	Yes
TE48	Private Practice	3/12/2021	7/3/1970	F	50.7	-	-	-	1	-	5	Mild	No	Yes
TE49	Private Practice	3/12/2021	7/14/2009	F	11.7	1	-	-	2	-	15	Mild	No	No
TE5	Private Practice	4/3/2021	12/21/2004	F	16.3	1	-	-	-	-	5	Mild	No	No
TE50	Private Practice	3/22/2021	10/20/1985	F	35.4	3	-	-	4	-	35	Moderate	Yes	Yes
TE51	Private Practice	3/12/2021	9/18/2007	M	13.5	1	-	-	3	1	25	Mild	No	No
TE52	Private Practice	4/20/2021	6/1/1955	F	65.9	1	1	-	-	-	10	Mild	No	No
TE53	Private Practice	4/20/2021	3/11/2008	M	13.1	-	-	-	-	-	-	Zero	No	No
TE54	Private Practice	4/20/2021	8/21/1991	F	29.7	-	-	-	-	-	-	Zero	No	No
TE55	Private Practice	4/20/2021	1/2/1959	F	62.3	3	3	2	-	1	45	Moderate	No	No
TE6	Private Practice	4/3/2021	8/5/2011	F	9.7	-	-	-	-	-	-	Zero	No	No
TE7	Private Practice	4/3/2021	10/26/1975	F	45.5	-	-	-	-	-	-	Zero	No	Yes
TE8	Private Practice	4/3/2021	1/27/1987	F	34.2	-	-	-	-	-	-	Zero	No	Yes
TE9	Private Practice	4/3/2021	8/29/2007	M	13.6	-	-	-	-	-	-	Zero	No	No