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Role of X-Ray in the Evaluation Of Asthma And Wheezing Severity

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Abstract. Patients with asthma experience exacerbations due to the airflow obstruction caused by the narrowing of lung passages. The exacerbations vary between simple and life-threatening, which is unpredictable. As a result, visits to the emergency department and hospitalization incur an enormous health care expenditure. Prediction on the severity of exacerbations is primarily vital to decide on the further course of treatment where conventional tests like spirometry provide mechanical aspects of the lung pathway obstruction. The advent of imaging modalities provides an advanced notion of the severity. Hence, in this review, the epidemiology of asthma, a diagnostic procedure using the different radiological techniques, various factors leading to lung pathway obstruction, and suitable medicines were discussed.

Keywords: chestX-Ray; Asthma;bronchial obstruction; CT, MRI.

1. Background

Asthma description has served as a source of contention. This is due, in part, to the fact that it manifests itself in a variety of phenotypes. Asthma is outlined by the Global Initiative in Asthma (GINA) task force as "a heterogeneous disease, usually characterized by chronic airway inflammation defined by a history of respiratory symptoms such as wheeze, cough, chest tightness, and shortness of breath that vary in time and intensity, together with airway limitation." In simple terms, asthma is a predicament in which a human's airways get to be distended, constrict, clump, and generate additional mucus, making breathing difficult.Asthma is a chronic inflammatory lung illness that is universally recognized as a health issue. The cost of this disease to the administration, medical institutions, patients, and their families is rising all over the globe. It is reported that an estimated 300 million asthma is geographically widespread, with an annual loss of 15 million disability-adjusted life spans due to respiratory problems [1].

2. Global prevalence

Nevertheless, large epidemiological research has revealed that bronchitis is a common fatal condition in the older population, with a concentration ranging from 4.5 percent to 12.7 percent. Furthermore, the older adults bear a greater load of asthma than their younger individuals, significantly in mortality, hospitalization, hospital expenses, and health-related standard of living. Despite this, asthma in the elderly (AIE) remains underreported and inadequately treated.Particularly, AIE might well be defined as a disorder with a late-onset.

According to the French number of elderly cohort 3C study, the prevalence rate of respiratory problems among the elderly was 3.0/1,000 person-years. In Italian general public surveys, the bronchitis overall incidence after 40 years of age was 2.27/1,000 person-years, and it increased with age beginning in the fourth decade of life. AIE may also have varying pathogenic mechanisms than childhood illness complicated interplay factors such as aging process lung and immunomodulation modifications, epigenetic modifications, exposure to toxic chemicals, microbiological provokes, or varied multimorbidity [2, 3].

2.1 Environmental factors

Numerous communities of kids and parents, as well as data from the United States, have been researched twice. All experiments found a higher, but the increment was relatively small than the rises seen with respiratory problems. The information is interesting even though alternative techniques, irritants, and weal size cut-off principles are being used in the research findings, and mite contaminant is not included in some initial research. The epidemiological variety in serological testing is especially widespread, and it cannot be clarified by discrepancies in techniques. In some inhabitants, the correlation between the preponderance of atopy and the pervasiveness of 'diagnosed asthma' is poor. Both atopy and asthma are common in communities that live ancient traditions, such as Indonesians, Papua New Guineans, and Australian Aborigines.The incidence rate varies considerably in communities where 50percent or more of the population is atopic, ranging from extraordinarily low in Asia to significant in the United States. As a result, it has seemed that the variables that influence atopy are distinct from those that determine respiratory problems. Positive skin steps were conducted in the Dunedin cohort researched by Sears in New Zealand, and the preponderance had enhanced to 66 percent. These elevated encasements values, as well as those discovered in some populations and the United States, imply that, given the right surroundings, a large number of communities can become sensitized to inhaled allergens. It sounds unlikely that a genetic factor is biologically predisposed to atopic status in general, though it may potentially lead to the intensity of allergic diseases that exists [4].

2.2 Allergen load

The food allergies load may be continuing to increase, but the scientific proof is mere speculation. A few data indicate an improvement in mite food allergy stages, and also most people will agree that living spaces in climate zones in which some residential heating is considered necessary in the winter have altered in the last 20 years. Two of the research findings provide substantiation that food allergies load is important. In a sample of youth in Sydney, those Australians - Born were found to be more prevalent to have respiratory problems than just those born in SouthEast Asia, and young kids who screened positive for dust-mite are much more likely to develop asthma if they live in cities with high mite stages than in cities with low arthropod levels [5].

2.3 History in the family

After controlling for allergic diseases, regression analysis reveals that a family's history of respiratory problems is an essential major health risk. A genealogy of respiratory problems was indeed a potential risk even in non-atopic asthmatic children. The relative risk for a

familial history has seemed to be approximately two to 3. Even though information from several communities, such as, recommend that bronchitis has a genetic predisposition that is self-sufficient of allergic diseases, the fair due of genes and shared surroundings must still be described [6].

2.4 Early respiratory infection

Whenever this question was posed in studies in proficient societies, chronic respiratory diseases before the age of two years were discovered to be a health risk. Furthermore, patients with respiratory infectious diseases appear to trigger asthma attacks. Nevertheless, there is corroborating evidence, regarding the lack of allergies in kids who live in ancient traditions, that initial sinus infections may be defensive, which makes sense if some infectious diseases enhance T helper (Th) 1 immune cell instead of Th2 immune cells [7].

2.5 Dietary lifestyle

A dietary change could be one of the causes of the rising incidence of childhood asthma. Peat lately examines the literature on the epidemiology of respiratory problems, and Weiss also discusses the role of diet. It appears likely that change in nutrition, with increased levels of certain nutrients and lower consumption of many others, will be identified as a component in the rising prevalence of diseases. Eating patterns are quickly evolving in many nations, and if the main consequences communicate with slightly earlier exposure to allergens and tobacco smoke, the total impact in terms of the total quantity of wheezy young kids in neighborhoods may be significant [8].

2.6 Lifestyle factors

Chosen to take around each other, global data indicate that eczema is on the rise in communities that no longer follow standard existences and that the 'relatively clean' the housing standards of communities, ever more likely sleep apnea will be present. What other factors related to modern (and possibly clean) lifestyle choices that have not yet been recognized in epidemiology could be an explanation for the increment in asthma attacks among atopic children? Presumably requiring small serious diseases in young life (due to fewer worms, smaller families per residence, smaller numbers shared private rooms, more immunization, and increased antibiotic use) is among the variables contributing to the rise in the incidence of chronic diseases. In theory, a barrier protection relationship between performance The passageways may be lost.

A further prospective health risk is the amount of basic activity. Because asthma is an illness in which the airspace gets narrowed excessively, there is very little wonder that the pulmonary muscle tissue is trying to behave anomalously. It was proposed that pulmonary muscle tissue can quickly reduce to the juncture where pass among actin and myosin boost, causing the myofibrils to behave as unless they're in a 'latch' nation and become much more challenging to unwind. In persistent asthma, the infection spreads to the epicardium layer, which thickens and is assumed to avoid the elongating impacts of deep breaths on muscle fibers. Without it, the body part may be more easily pushed into the ‘latch’ state.

Airway infections caused by ongoing interactions to allergic in atopic kids without respiratory problems may assist in the growth of respiratory problems if these kids have a low amount of fitness (e.g., if they watch many hours of television) since these kids do not extend their respiratory system, enabling some blood vessels to constrict or close. The lowering infection, mediator discharge, and core strength that is not adequately extended allow the muscles to start behaving in an asthmatic manner. Furthermore, there's an indication that in communities where the tv is readily available, kids exercise less [9].

3. Radiological Techniques for Diagnosis

Many researchers have demonstrated that neuroimaging methods can also be used to discern the difference between anyone with breathing problems from someone with relatively mild illness in the last few centuries, and there is a connecting difference about what position scanning may perform in both diagnoses and drastic asthma sufferers.

3.1 Chest radiography (CXR)

Chest radiographs (CXR) are generally obtained like most asthmatics; nevertheless, this is to govern out other illnesses that may imitate the airway inflammation or to take a glance for health problems. If CXR reveals an irregularity that necessitates further investigation, chest approximated tomography (CT) is used as the reference standard to diagnose conditions or assess for health problems. Clients with complicated or breathing problems, chronic obstructive pulmonary disease (COPD) and respiratory problems, and infrequent disperse and pulmonary fibrosis are all candidates for a chest CT. The advancement of respiratory problems has now been assessed using work of breathing, examination findings, and a chest X-ray (CXR) [10]. However no solitary criterion has been recognized to check for signs of respiratory problems, CXR is a viable technique of bronchitis evaluation since it enables to rule out other disease processes such as edema, bronchogenic melanoma, intraventricular inability, and bronchiolitis. A chest X-ray (CXR) contains the neck, airlines, respiratory system, cardiovascular system, large vasculature, ribs, and esophagus; thus, it contains a wealth of healthcare data and organ systems that can be impacted by morphological features in the airways that underpin the congenital abnormalities exhibited by persistent abscesses in the air passages.Work of respiration, clinical examination, and a chest X-ray have now been used to assess the progression of respiratory problems (CXR). Although no single requirement has been identified to check for the presence of breathing difficulties, CXR is a promising method of bronchitis assessment because it allows for the exclusion of all other pathological conditions including edema, bronchogenic melanoma, intraventricular incapability, and bronchiolitis. A chest X-ray (CXR) includes the throat, air carriers, bloodstream, vascular system, large vasculature, ribs, and esophagus, containing a capital of health insurance data as well as this thus which can be influenced morphologically in the airways that underlie the rare genetic irregularities displayed by enduring hematoma in the upper airways.Sonography could be used to picture collapsed lung, pulmonary edema, and bronchitis in the clinic, and adaptable endoscopic is used to assess airway physiology [11].New imaging modalities, such as quantitative CT and lung magnetic resonance imaging (MRI), can be used to characterize lung underlying mechanisms in therapeutic interventions. Imaging procedures, which include technical (e.g., radiation) and physician (e.g., depth of

inhalation) variables, must be medically efficient, safe, and dependable in the process of translating to clinical practice. Local radiographers and healthcare professionals must perceive the image easily and quickly in real-time. The advantages of acquiring the picture for the patient should outweigh the costs. Including an expanding quantity of computed tomography accessible to picture the lung tissue, physicians must comprehend how these detection methods can aid in the provision of healthcare services. Health professionals should be prepared to describe to their sick people the costs and rewards of these processes, as well as plan how they will integrate new medical disciplines into their practices. This viewpoint provides a summary of computed tomography that looks promising in terms of improving personalized patient services in patients with asthma. In the large percentage of lung illnesses, CXR remains the most commonly utilized mechanism of action to analyze the air passages, lungs, and mediastinum. CXR can reveal non - specific research results in asthmatics, such as peribranchial hypertrophy and high inflation. Its principal use is to rule out other treatments with mild problems or to look for health problems such as infiltrates, pneumothorax, or pneumomediastinum. According to research, CXR findings tend to be inflexible diagnostic asthma governance, so therapeutic approaches have been targeted to reduce the number of radiation therapy research done in repetitive patient education. In sick people with some other lung diseases, x-ray plays a greater role in clinical studies as a helpful outcome measure and assistance in illness able to be monitored over time. Considering the low yield in allergies to date, CXR has several pluses, including wide introduction, relatively inexpensive, and low radioactivity. More research is required to determine whether recorded data in such conventional pictures can be used for diagnostic purposes, as was demonstrated in sick people with those other illnesses.

The role of chest radiography in severe asthma planning has been suggested earlier, although there have been a handful of significant developments in this neighborhood. It is worth mentioning, however, that radiograph persists to play a significant role in the initial treatment of asthmatic patients, such as during admittance for acute exacerbation. White et al. [12] found major radiograph irregularities in 34% of 58 patients who are admitted for asthma attacks and minor irregularities in 41% of the remaining patients in a preliminary study of 58 patients for asthma symptoms. Thrombus and results also indicate are perhaps the most worrisome of these observations.Although the rate of the collapsed lung in sick people conceded for status asthmaticus has been flagged up to be between 0.5 and 2.5 percent, it was the instantaneous cause of mortality in 27 percent and those who dropped dead from their asthma symptoms in at least one sequence. Formalized However there is some discussion about the responsiveness of mammography for pneumothoraces, it continues to be a significant efficient imaging modality for huge obtained on the basis and is up to 88 percent sensitive for pneumothorax under laboratory conditions when conducted in the lithotomy position.

3.2 Computed Tomography (CT)

Diagnostically, computed tomography (CT) imagery in asthma is used primarily to diagnose troubles and medical comorbidities. As noted previously, the thrombus is a rare condition contraindication of persistent asthma that mainly occurs in the configuration of prestige asthmatics. Chest CT is widely recommended for being able to diagnose pneumothorax and is

particularly useful in severe asthma symptoms with acute hypotension or even when the practice implies the potential of such a pneumothorax, except when high airway pressures are set on respiratory support. Computed tomography may also assist clinicians of asthma-related illnesses such as autoimmune disease respiratory infections, angioedema pneumonitis, and angioedema similar to symptoms that are associated.

There must have recent times been a greater emphasis on quantifiable CT initiatives of pathogenicity in respiratory problems. Comparable to the qualitative assessment of radiograph, the key results of involvement on CT scans of asthma sufferers, extremely devastating steroid inhalers, can be divided into those relating to morphometric adjustments in the upper airway as well as those indicating peripheral vascular dysfunction, demonstrated mainly as natural differences of high inflation. Almost all of the job in the statistical analysis of upper airways, in specific, has concentrated on CT metrics of respiratory system plate thickness, wall neighborhood, and orifice area. For example, as a component of the National Library of Medicine Severe Asthma Research Program, Aysola et al [13] presented automated dimensions of 3rd generation upper airway in 123 subjects. While the airway inner surface was not considered to be greater in severe asthma symptoms particularly in comparison towards those with mild asthma or no illness, sheet thickness proportion (wall thickness divided by outer airway diameter) has been greater in someone with breathing problems. The proportion of pipe diameter was also negatively linked to the baseline % anticipated forced expiration quantity in one 2nd (FEV1 percent) and significantly associated with the transformation in FEV1 % with bronchodilator challenging tasks.

3.3 Magnetic Image Resonance (MRI)

While largely used in the investigation, magnetic resonance imaging (MRI) was shown to have several possible values for imaging people with severe allergies. The ability to provide images that depict the spatial pattern of ventilation imperfections in asthma throughout the whole lung is one of the most important. This is especially true for MRI, which uses hyperpolarized gas, generally hyperpolarized helium or xenon [14]. Indicators of these ventilation imperfections have already been linked to lower FEV1/FVC ratios, higher methacholine attentiveness, and higher elapsed nitric oxide thresholds in adult women, but also greater inhaler doses, lower FEV1/FVC ratios, and lesser Asthma Management Test scores in kids. The main therapeutic disadvantage of this approach, particularly in those with clinical complications, is that the ingested gas, that is a helium-nitrogen combination in the particular instance of the more frequently used 3He technique, is anoxic and disturbs air from the lungs. This causes discipline of study during the exhalation hold maneuver, though they are usually not just under 90%. Continued research into oxygen-enhanced Magnetic resonance may help to alleviate this issue. Another issue is that the exhalation hold maneuver can take up to 20 seconds that might be inconvenient for asthmatic patients.

4. Causes of asthma

Pneumonia can indeed be characterized by a causative agent as there are so many, or by pathogenesis because the pathologic features that are frequently perceived are not specific to asthma. As a result, various cellular kinds of inflammatory responses are prevalent to comorbid respiratory disease in a broad sense. Numerous different characteristics of

respiratory problems include also is muscular strength in the upper airways in affected children and non-cystic fibrosis bronchiolitis, epithelium hypertrophy in seasonal allergies without respiratory problems and in asymptomatic individuals with AHR, and endothelial denudation seen in endobronchial tissue samples, which could be an artifact but doesn't always correspond with the symptom severity, AHR, and obstruction in the airflow.Pneumonia is identified as a part of organizational patient's condition in this nominalist meaning. At about the same moment that allergies were characterized in this manner, COPD was and continues to be characterized as a particular irregularity of airway resistance as 'a an illness characterized by airflow obstruction that is just not usually temporary.' Post-bronchodilator measurement is mainly used to find this.Nevertheless, because airflow restriction may be caused by allergic asthma, this must be inverted or minimized before COPD is identified. Alternatively, what appears to be COPD because once, for instance, microtubule eosinophilic clinical presentation is prevalent may well not be so when an inflammatory response has now been treated properly.

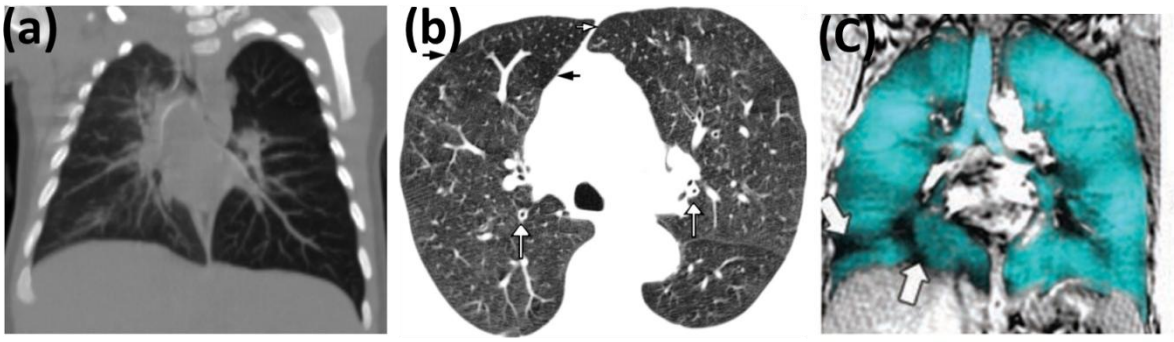

Figure 1. (a) Chest X-ray, (b) high-resolution CT scan, and (c) He MRI of different asthma subjects adopted with permission from [11, 13, and 14]

4.1 Atopy

To date, its most globally known genetic determinant of children's bronchitis growth in published data is an atopic illness. A substantial body of evidence underlines the concept of atopy as a potential cause for airway inflammation. The popular use of atopy as a set of variables (i.e., sensitized or non-sensitized) in clinical practice, as with most research findings, is a significant obstacle to recognizing the correlational interactions among both atopy and breathing problems [15]. Undoubtedly, positive IgE desensitization to an immune reaction does not always result in diagnostic reactions upon antigen exposure, and a large percentage of such 'atopic' children do not create autoimmune disorders.

4.2 Occupational

A current workplace excitation source, characterized as an agent that stimulates respiratory problems through some kind of framework linked to a specific symptom, could indeed cause respiratory disease. Employment sensitizers are normally high agencies (>10 kD, usually a protein or glycopeptide) that can induce the formation of specific IgE antibodies as well as pretty standard allergic reactions. When sensitized, even low-level stressors can trigger asthma, which is commonly linked with rhinoconjunctivitis. Every year, new influences are

identified, and it appears that almost any nutrient that has become present in the air and breathed could be a prospective cause of workplace respiratory problems [16].

4.3 NSAID Intolerance

Aspirin illiberal asthma (AIA) is a medically distinct condition marked by the precipitation of respiratory problems by aspirin and other non - steroidal anti-inflammatory drugs (NSAIDs). What many patients' clinical signs in their 3rd or 4th years of life progress in a predictable pattern. Persistent nasal congestion, anosmia, rhinorrhea, and nasal polyps are common over several quarters. Hypersensitivity generally follows, and then aspirin and/or NSAIDs cause immediate asthma symptoms. Such threats usually happen within about an hour of taking aspirin and are supplemented by profuse rhinorrhoea, conjunctival annoyance, and rinsing of the neck and shoulders. Notably, the awareness persists over time, and the patient's bronchitis persists in the prevention of paracetamol and NSAIDs [17].

4.4 Infections

In adults of all ages, gasping for breath diseases is connected with viral lung problems. Researchers can seek to assess the significant correlation between bronchospasm episodes and chest illnesses in childhood by learning the affiliation among these happenings and the advancement of breathing problems. This relationship has been analyzed the most with breathing diseases caused by RSV or HRV.

RSV bronchiolitis in infants resembles acute breathing problems in very many ways, including bronchial asthma, breathlessness, tiny bronchospasm, and, in some kids, respiratory concessions. A majority of students who have an initial expiratory episode due to bronchiolitis can have reoccurring gasping for air incidents. This link has led to the suggestion that serious RSV bronchiolitis in childhood triggers the advancement of respiratory problems [18].

4.5 Smoking

A percentage of studies have been conducted to investigate the rates of co-occurring asthma and smoking. Several studies have looked at the preponderance of comorbid asthma and smoking in adolescents. For comparison purposes, Zbikowski [10.1016/s1054-139x(01)00394-9.] and colleagues investigated that those with prevailing or past respiratory problems (self-report of physician-diagnosed asthma) had been nearly 1.5 times more likely than otherwise respiratory problems to stop smoking at least weekly in a specimen of female-dominated, minimal, African American high school students. Amusingly, the risk factors for smoking (e.g., smoking friends, household smoking) did not differ among even those without respiratory problems, with the exception that non-asthmatics who assumed cigarette consumption was soothing were more smokers than asthmatic patients [19].

5. Treatment

There are standard prerequisites for supplying pharmaceutical particulate matter to both children and adults, which are as follows: optimal crystallite size range (1–5 m aero diameter), negligible oropharyngeal accumulation, and simple, inexpensive, and dependable aerosol gadgets. Nevertheless, pediatric patients have additional needs that adults do not have

or do not have as much of. Family's lower vital capacity ability to focus dose delivery. Newborns' and children's respirations are also extremely unpredictable. Their respiratory muscles flow rates range from nearly zero to approximately forty L/min. Furthermore, infants are unable to embrace any prescribed respiratory rate, because they can hardly breathe tidal forces through to the nasal passages.

As a result, they must require facemasks for aerosol administration. Children aged two and a half to three years old would be able to use a propaganda outlet. If the infant or child is emotionally upset and cries, the delivery of drugs will be compromised. The respiratory rate will change, and the inspiratory flow rate will increase, resulting in increased accumulation in the proximal air passages. That whenever a child is struggling, the facemask seal will also become loose, resulting in an aerosol leak. When designing, testing, and using pharmaceutical aerosol products to optimize delivery in kids, the difficulties mentioned above must be taken into account.

6. Conclusion

Asthma is a common chronic illness that burdens the healthcare systems in terms of the workload faced by physicians and radiographers. Proper control and regular maintenance of such illness may reduce the mortality rate which is evident with the advent of modern imaging technologies. This also provides an opportunity to diagnose at the window of opportunity and reverse the impact of illness. Given this, various techniques discussed in this review provide evidence on diagnosis and severity reduction of asthma in a diverse population of age, sex, and nationality.

References

[1] Gherasim, A., Dao, A. & Bernstein, J.A., 2018, ‘Confounders of severe asthma: diagnoses to consider when asthma symptoms persist despite optimal therapy’, World Allergy Organization Journal, 11, 29.

[2] Fukutomi, Y., Nakamura, H., Kobayashi, F., Taniguchi, M., Konno, S., Nishimura, M., Kawagishi, Y., Watanabe, J., Komase, Y., Akamatsu, Y., Okada, C., Tanimoto, Y., Takahashi, K., Kimura, T., Eboshida, A., Hirota, R., Ikei, J., Odajima, H., Nakagawa, T., Akasawa, A. & Akiyama, K., 2010, ‘Nationwide Cross-Sectional Population-Based Study on the Prevalences of Asthma and Asthma Symptoms among Japanese Adults’, International Archives of Allergy and Immunology, 153(3), 280–287.

[3] Yáñez, A., Cho, S.-H., Soriano, J.B., Rosenwasser, L.J., Rodrigo, G.J., Rabe, K.F., Peters, S., Niimi, A., Ledford, D.K., Katial, R., Fabbri, L.M., Celedón, J.C., Canonica, G.W., Busse, P., Boulet, L.-P., Baena-Cagnani, C.E., Hamid, Q., Bachert, C., Pawankar, R. & Holgate, S.T., 2014, ‘Asthma in the elderly: what we know and what we have yet to know’, World Allergy Organization Journal, 7, 8.

[4] Woolcock, A.J. & Peat, J.K., 2007, ‘Evidence for the Increase in Asthma Worldwide’, in D.J. Chadwick & G. Cardew (eds.), Novartis Foundation Symposia, pp. 122–139, John Wiley & Sons, Ltd., Chichester, UK.

[5] Wu, F. & Takaro, T.K., 2007, 'Childhood Asthma and Environmental Interventions', Environmental Health Perspectives, 115(6), 971–975.

[6] Burke, W., Fesinmeyer, M., Reed, K., Hampson, L. & Carlsten, C., 2003, 'Family history as a predictor of asthma risk', American Journal of Preventive Medicine, 24(2), 160–169.

[7] Smit, L.A.M., Bouzigon, E., Pin, I., Siroux, V., Monier, F., Aschard, H., Bousquet, J., Gormand, F., Just, J., Le Moual, N., Nadif, R., Scheinmann, P., Vervloet, D., Lathrop, M., Demenais, F., Kauffmann, F., & the EGEA Cooperative Group, 2010, '17q21 variants modify the association between early respiratory infections and asthma', European Respiratory Journal, 36(1), 57–64.

[8] Devereux, G. & Seaton, A., 2005, 'Diet as a risk factor for atopy and asthma', Journal of Allergy and Clinical Immunology, 115(6), 1109–1117.

[9] Huovinen, E., Kaprio, J. & Koskenvuo, M., 2003, 'Factors associated to lifestyle and risk of adult onset asthma', Respiratory Medicine, 97(3), 273–280.

[10] Calabrese, E.J., Dhawan, G. & Kapoor, R., 2015, 'The Use of X Rays in the Treatment of Bronchial Asthma: A Historical Assessment', Radiation Research, 184(2), 180–192.

[11] Al Shamrani, A., AlShammari, A., AlAlkami, H., AlShanwani, J. & Alharbi, A.S., 2021, 'When is asthma not guilty?', International Journal of Pediatrics and Adolescent Medicine, 8(4), 203–211..

[12] White, C.S., Cole, R.P., Lubetsky, H.W. & Austin, J.H.M., 1991, 'Acute Asthma', Chest, 100(1), 14–16.

[13] Silva, C.I.S., Colby, T.V. & Müller, N.L., 2004, 'Asthma and Associated Conditions: High-Resolution CT and Pathologic Findings', American Journal of Roentgenology, 183(3), 817–824.

[14] Eddy, R.L., Svenningsen, S., Licskai, C., McCormack, D.G. & Parraga, G., 2019, 'Hyperpolarized Helium 3 MRI in Mild-to-Moderate Asthma: Prediction of Postbronchodilator Reversibility', Radiology, 293(1), 212–220.

[15] Di Cicco, M., D'Elios, S., Peroni, D.G. & Comberiati, P., 2020, 'The role of atopy in asthma development and persistence', Current Opinion in Allergy & Clinical Immunology, 20(2), 131–137.

[16] Tarlo, S.M. & Lemiere, C., 2014, 'Occupational Asthma', New England Journal of Medicine, 370(7), 640–649.

[17] Vally, H., 2002, 'The prevalence of aspirin intolerant asthma (AIA) in Australian asthmatic patients', Thorax, 57(7), 569–574.

[18] Busse, W.W., Lemanske, R.F. & Gern, J.E., 2010, 'Role of viral respiratory infections in asthma and asthma exacerbations', The Lancet, 376(9743), 826–834.

[19] McLeish, A.C. & Zvolensky, M.J., 2010, 'Asthma and Cigarette Smoking: A Review of the Empirical Literature', Journal of Asthma, 47(4), 345–361.

[20] Blease, K., Lewis, A. & Raymon, H.K., 2003, 'Emerging treatments for asthma', Expert Opinion on Emerging Drugs, 8(1), 71–81.