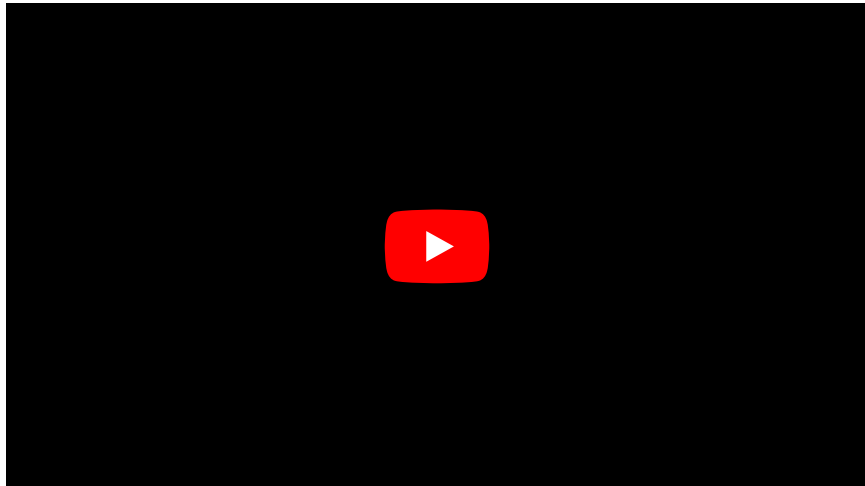
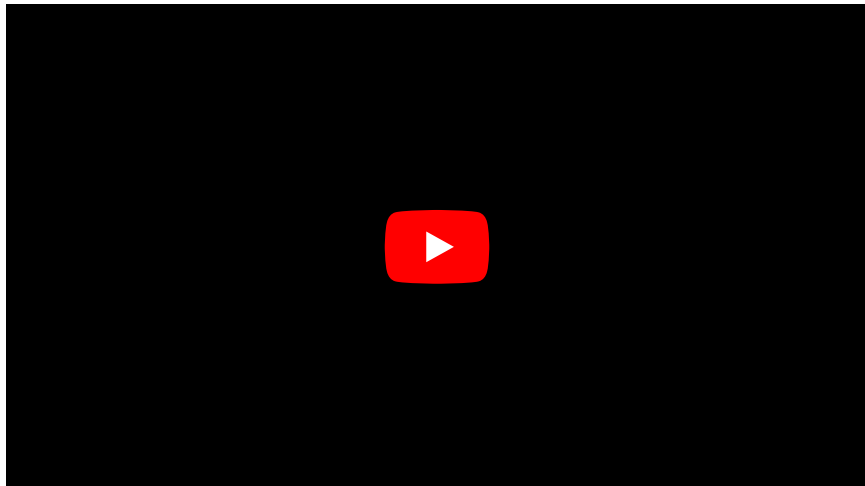


Asthma

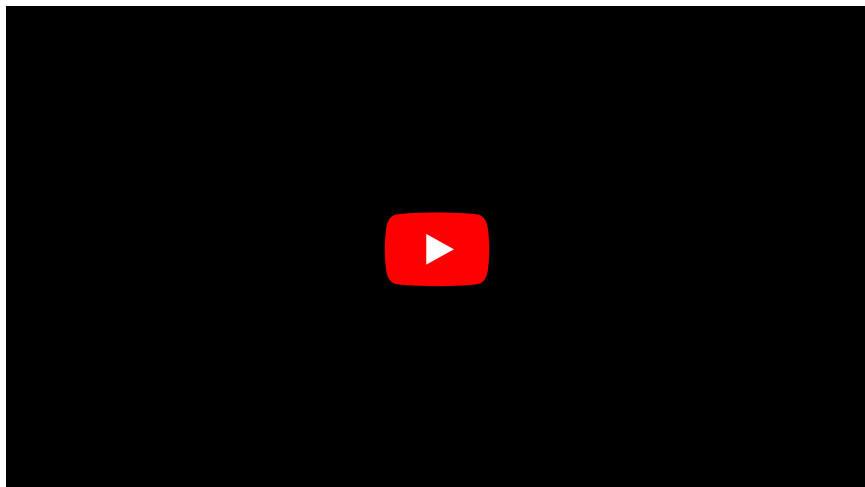
Asthma:



Asthma 2:



Asthma vs COPD:



DLCO:



Template:Infobox - disease

Asthma is a chronic inflammatory disease of the airways. These inflamed pathways, when exposed to the influence of various risk factors, become hyperreactive, obstructed and have limited patency due to bronchoconstriction, the presence of mucus glands and increased intensity of inflammation. The clinical manifestation is repeated wheezing, shortness of breath, chest pressure and cough, especially at night and early in the morning. The prevalence of asthma is constantly increasing, especially in children. Asthma is one of the most common chronic diseases.^{[1][2]}

In Europe, the prevalence is about 5% (with a variance of 10-12%), with up to 63% occurring before the age of 5.

Pathophysiology

The essence of asthma

- inflammation of the airways, which is present even if the disease is without clinical symptoms;
- genetic, developmental and environmental factors;
- in childhood, **allergic eosinophilic inflammation** is usually present, which induces remodeling of the airways.

Changes in the bronchi (sometimes irreversible)

- smooth muscle hypertrophy, increased vascularization and angiogenesis, cellular inflammatory infiltration, collagen deposition, basement membrane thickening, and reduced elasticity;^[1]
- dendritic cells, T regulatory lymphocytes, IL-4, IL-5 and IL-13 are applied;^[1]
- in small children, due to the anatomical conditions, the airways are narrower, and therefore their obstruction occurs more easily;^[1]
- the degree of chronicity and irreversibility is lower in children compared to adults, and the possibility of successful treatment is better.
- the main risk group – atopics (allergies in RA);
 - a pre-asthmatic condition can be considered – atopic dermatitis (40-60% risk of developing asthma), allergic rhinitis;
 - **atopic syndrome** is often spoken of in this sense.

Conditions of origin

- predisposition – family or personal (atopy);
- causative allergens – the more frequent and greater the exposure, the greater the risk;
- supporting influences – respiratory infections, immunodeficiency and immunological dysfunction, passive smoking, environmental pollutants;
- triggering factors – allergens, infections, harmful substances, physical or mental stress, sudden changes in temperature, cold

Clinical picture

- It manifests itself **in conditions of difficult breathing or expiratory dyspnea**, often with whistling or wheezing on exhalation;
- typically occurs in the second half of the night or after exertion;
- the child feels distress, pressure on the chest, a feeling of lack of air;
- it is often accompanied **by an irritating dry cough**;
- further: frequent episodes of wheezing without seasonal variability, coughing or wheezing caused by physical exertion, night cough outside the period of respiratory infections, symptoms appear or worsen in the presence of animals, when exposed to pollen, house dust, tobacco smoke, changes in temperature, strong emotional

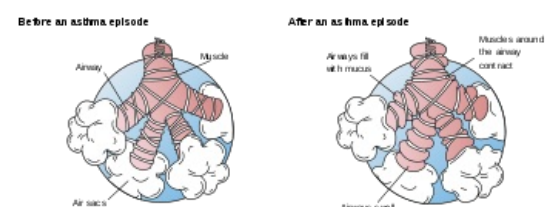
experiences, ...^[1]

Age considerations

- Asthma can arise at any age (purely theoretically, it cannot arise before the age of 1 - the smooth muscles of the bronchi are not yet developed and it can hardly be considered a chronic disease in the first year, similar to asthma at this age - recurrent obstructive bronchitis).
- **Infant and toddler age (0-3 years):**
 - in half of the cases it starts before the age of 3 - childhood asthma - the symptoms are not yet typical - the child suffers from respiratory infections (mainly viruses), the common denominator is obstructive bronchitis;
 - the most important indicator is the severity of the disease;
 - if the child wheezes several days a week during the last 3 months, after ruling out other causes, we are talking about *persistent wheezing type of asthma* ;
 - in the case of intermittent manifestations, we further distinguish between *light and severe intermittent type* .
- **Preschool and school age (3-6 years):**
 - asthma of school age and adolescence is no longer very different from the symptoms in adulthood (only the so-called triggers of the acute condition differ);
 - 1. in the interim period between asthma symptoms, the child is completely symptom-free;
 - A - problems are provoked by colds - *asthma induced by viruses*;
 - B - problems arise after greater movement - *stress-induced asthma*;
 - 2. *asthma induced by allergens or the cause of asthma has not been determined* .
- adolescence - new problems: irregular use of medicines, smoking, changing doctors, ...^[1]

Diagnosis

- Anamnesis - information about family burden, relationship of symptoms to place, seasonality, living situation, ...;
- clinical picture;
- physical examination - outside of an acute condition, it is usually normal;
- **functional examination of the lungs** (spirometry) - for cooperating children (over 4-5 years of age), it belongs to the basic procedures;
- **positive skin tests with allergens**, event. positivity of specific serum IgE antibodies;
- FEV1 may be normal, but the flow-volume curve shows small airway obstruction. honor;
- unclear cases - histamine inhalation challenge test to assess bronchial reactivity;
- when obstruction is found, it is good to perform a bronchodilation test to assess reversibility.



Airway before and after a seizure

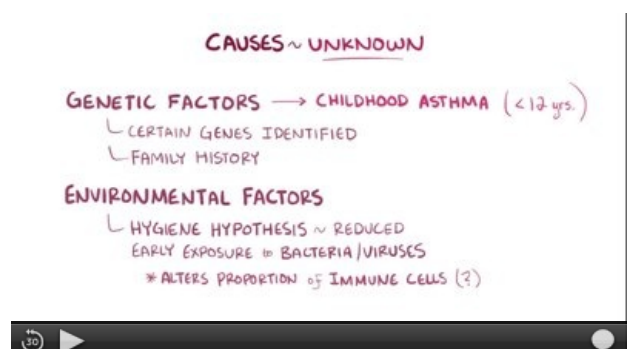
Differential diagnosis

- Acute viral respiratory infections, recurrent obstructive bronchitis , recurrent sinusitis , bronchiolitis , CF , VSV , heart failure , pulmonary embolism , GER (we will examine 24-hour pHmetry and bronchoscopy), bronchial stenosis, tracheomalacia , foreign body (often underestimated), anaphylaxis, toxic inhalation, anatomical deviations are also a frequent cause of severe acute conditions;
- bronchoscopy is still wrongly considered a too invasive examination;
 - indications - stridor , atelectasis , persistent wheezing, suspicion of a foreign body, recurrent and persistent pulmonary infiltrates, unexplained cough, repeated severe acute pain.

Classification of asthma

According to the severity of the manifestations, the degree of airway obstruction and its variability

- **Intermittent:**
 - occasional episodes of seizures, no more than 1x a week, no more than 2x a month at night;
 - normal function between attacks, spirometry (PEF, FEV1) above 80%, full life activity.
- **Persistent mild:**
 - symptoms even several times a week, night problems several times a month;
 - spirometry (PEF, FEV1) between attacks still above 80% of values;
 - disruption of sleep and daily activities is already evident.
- **Persistent moderate:**
 - daytime attacks even every day, nocturnal attacks even several times a week;
 - the patient requires almost daily



Video in English, definition, pathogenesis, symptoms, complications, treatment.

- bronchodilators;
- spirometry values at rest 60–80%.
- **Persistent severe asthma:**
 - permanent symptoms with significant limitation of physical activity, nighttime difficulties;
 - on spirometry, there is a state of permanent obstruction (values below 60%).

By level of control (GINA, 2006)

- Asthma under control;
- asthma partially controlled;
- poorly controlled asthma;^[2]
- It is based on a detailed description of symptoms, their frequency and severity (an important indicator – consumption of relief bronchodilators);
- completeness also includes assessment of bronchial reactivity and lung function;
- the goal is for the patient (school children, adolescents) and parents (small children) to participate in the assessment.
- Ongoing assessment includes:
 - **daily symptoms;**
 - **nocturnal symptoms:** record the frequency of nocturnal symptoms – at night and in the morning, feelings of tightness in the chest;
 - **activity limitation:** how it limits normal daily activities;
 - **the need for relief drugs:** indication of the use of β 2-agonists for acute problems;
 - **lung function:** monitoring of lung function and bronchial reactivity;
 - spirometry – recording of the flow-volume curve reliably reveals latent obstruction;
 - by administering a bronchodilator, we evaluate the reversibility of the obstruction;
 - asthma (even asymptomatic) should be min. spirometrically checked once a year;
 - inhalation provocation test with histamine or acetylcholine, serves to objectify bronchial reactivity;
 - use – for diagnosis of asthma, for evaluation of therapy, for assessment purposes;
 - indicative examination of PEF with an exhalation meter (peakflowmeter) – every asthmatic should have one;
 - while standing, after a labored inhalation, a labored exhalation into the device (we record the best value from three attempts), it is usually measured in the morning and in the evening;
 - the norm is the best value of the patient inspired at rest;
 - the important value is the variability of daily values;
 - $IV = (PEF\ evening - PEF\ morning) / \text{average of these PEFs} \times 100$;
 - variability up to 20% indicates stabilized asthma.

According to ABR

1. Respiratory alkalosis,
2. normal pH (muscle fatigue) – normal pH in an asthma attack is not normal!!
3. respiratory acidosis.

Therapy

- The main goal is **to bring asthma under control** so that it does not manifest itself in shortness of breath and does not limit the child in normal activities.
- Asthma control means:
 - disappearance of chronic symptoms;
 - reduction of symptoms to isolated acute exacerbations;
 - no or minimal consumption of relief drugs;
 - stabilization of lung function, low variability of PEF;
 - normal physical performance.
- **Pharmacotherapy + elimination of contact with** possible allergens allergen immunotherapy + **climatic treatment** (spa, stay by the sea, speleotherapy, rehabilitation, psychotherapy).
- *Education* of the child's loved ones - we inform the family, the child, for school children the teacher should also receive the information.
- *Care of the environment* – optimal temperature and humidity (19–20 °C, 40–50% relative humidity), creating an allergen-free environment (making the bed, pets), removing harmful substances from the apartment (hood above the gas stove, parental smoking, etc.) .
- *Remediation of infectious sites* - repeated HCD infections can often trigger asthma or accompany it - in preschoolers, the routine examination includes the verification of adenoid vegetation, always adenotomy if positive.
- *Specific allergen immunotherapy* (SAIT) – an essential treatment intervention, mainly for seasonal pollen asthma or asthma with dust mite allergy, it is actually a vaccination, the treatment lasts three years.

Pharmacotherapy

- We have two main groups of medicines: short-acting *relief medicines* to help with acute conditions and *preventive* , anti-inflammatory medicines for maintenance treatment, controlling asthma.
- Preference is given to inhalation administration, while the method of inhalation is as important as the medicine itself - it should be thoroughly practiced with the patients - whenever the administration of the

medicine fails, it is necessary to check the method of administration, only then is it possible to consider adjusting the dose, changing the interval or even medicine.

Rescue (relief) drugs

- Short-acting β_2 -mimetic;
- other bronchodilator drugs.^[2]

Preventive (checking) drugs

- Inhaled corticosteroids,
- antileukotrienes,
- long-term effective β_2 -mimetic,
- retarded theophyllines,
- chromones,
- oral corticosteroids ,
- anti-IgE-antibodies^[2]

Movement therapy

- Endurance training is suitable for adult patients, 20-30 minutes a day, it can be combined with resistance training.
- Interval training is suitable for heavier patients.
- For children, any varied movement activity can be recommended to strengthen the overall fitness of the organism.
- Appropriate exercise therapy can also reduce the number of seizures, as the individual's resistance to cold and fatigue will increase.
- In the event of post-exercise bronchospasm, we can use the refractory period.^[3]

A drug used to treat asthma

▪ **Short-acting β_2 -agonists**

- mechanism of action:

they stimulate sympathetic beta receptors and thereby cause dilation of the bronchi, reduce cholinergic reflex and plasma exudation, increase mucociliary clearance, stabilize mast cell membranes,

- they are used irregularly, as needed to suppress acute attacks, in case of shortness of breath,
- they can also be used preventively against physical stress,
- the effect lasts about 4 hours, preferably inhalation form,
- this includes: **salbutamol , fenoterol , terbutaline** .^[2]

▪ **Long-acting β_2 -agonists**

- the effect lasts for 12 hours or more, so they can be administered twice a day,
- use – for nocturnal attacks, prevention of post-exercise asthma, in combined treatment as a supplement to anti-inflammatory preventive therapy of more severe types of the disease,
- they can also be administered regularly for a long time, but only with concurrent anti-inflammatory steroid or non-steroid treatment,
- **salmeterol , formoterol**.
- oral: **clenbuterol , procaterol**.^[2]

▪ **Anticholinergics**

- mechanism of action:
 - they inhibit the action of acetylcholine on muscarinic receptors, suppress the bronchoconstriction thus induced and reduce vagal tone;
- as an adjunct to treatment in an acute setting or where sympathomimetic therapy is contraindicated;
- they are suitable for children where the symptoms are associated with an irritating cough;
- in our country, the only representative is **ipratropium bromide** - aerosol, inhalations, solution for nebulization;
- on its own, its effect is smaller - it can be combined with fenoterol or salbutamol.

▪ **Xanthines**

- mechanism of action:

inhibition of phosphodiesterase and thus increase in cAMP concentration;
bronchodilation, stimulation of the diaphragm and respiratory center;
decrease in vascular pulmonary resistance and increase in myocardial perfusion;
decrease in the tone of the lower esophageal sphincter → emergence of gastroesophageal reflux;

- this includes **theophylline** and **aminophylline**.

▪ **Short-acting theophyllines**

- aminophylline po or inj., duration of effect is 4-6 hours;

- injection application comes into consideration for severe asthma attacks in combination with β 2-agonists and corticoids - mostly during hospitalization;
- caution - if the child is already being treated with a retarded form of theophylline - monitor plasma levels;
- tachycardia, palpitations, nausea, vomiting, headaches, convulsions;
- **Long-acting theophyllines;**
 - the duration of effectiveness is 12–24 hours, they also contribute to anti-inflammatory activity;
 - in chronic persistent forms - only in combination with anti-inflammatory treatment;
 - again especially in nocturnal asthma;
 - they are not given long-term as monotherapy.
- **Corticosteroids**
 - mechanism of action:
 - suppress the development of inflammation, reduce infiltration of the bronchial wall by eosinophils, reduce plasma exudation and mucus secretion;
 - in daily doses up to 200 μ g, they do not cause any side effects in most people;
 - NU (800 μ g/day and more): slowing of growth in children, effect on the function of the hypothalamus-pituitary-adrenal axis, reduction of bone density;
 - slow onset of action;
 - we start the treatment with a higher dose, after a few months we reduce it;
 - **beclomethasone, budesonide, ciclesonide, fluticasone;**
 - inhaled corticoids are administered before meals, after administration we rinse the mouth (then spit it out);
 - inhaled corticoids – dysphonia (voice change, hoarseness), oropharyngeal candidiasis (rare).
- **Antileukotrienes**
 - mechanism of action:
 - dampens the effect of pro-inflammatory mediators, leukotrienes, released from cell membranes of mast cells, eosinophils and others;
 - leukotrienes cause stronger bronchoconstriction than, for example, histamine (they are the strongest endogenous bronchoconstrictor), increase mucus secretion and vascular permeability, increase the amount of eosinophils in the walls of the bronchi;
 - leukotriene receptor antagonists: **montelukast, zafirlukast** – orally;
 - for children from 3 years old;
 - for the prophylaxis of all forms of persistent asthma, aspirin-induced asthma (suppresses the reaction to ASA or NSAIDs) and exercise-induced asthma;
 - dosage:
 - zafirlukast twice a day, its effect is reduced by erythromycin, theophylline or terfenadine;
 - montelukast once daily in the evening, drug interactions unknown.
- **Anti-IgE antibodies**
 - recombinant humanized monoclonal antibodies;
 - mechanism of action:
 - by binding to IgE, they reduce its levels in the body and at the same time prevent the binding of IgE to receptors on the surface of mast cells and basophils - thereby preventing their degranulation with the subsequent release of mediators;
 - they also inhibit the release of newly formed IgE from B-lymphocytes;
 - difficult-to-treat asthma with the participation of IgE antibodies;
 - by injection, for children over 12 years old - so far only in specialized centers!!!^[2]
- **Cromons**
 - disodium cromoglycate – stabilizes the membranes of histiocytes, basophils and eosinophils, thereby reducing the release of inflammatory mediators;
 - it is administered 4 times a day (with long-term administration, the cooperation of patients and parents decreases);
 - originally applied in powder form (Intal);
 - in mild and moderate forms of persistent asthma and in post-exertional asthma;
 - nedocromil sodium – similar indications, affects chloride channels bb. → also reduces neurogenic sensory irritation, thereby suppressing irritation to cough;
 - its advantage is administration twice a day.

Combined treatment

- If asthma control already requires repeated doses of short-acting β 2-agonists and increasing doses of corticoids, then combination therapy is considered;
- borderline doses of inhaled corticosteroids;
 - for children of early and preschool age – 400–600 μ g/day;
 - for school children – 800–1000 μ g/day

Inhalation systems

- Dosed aerosol inhaler – the most widespread, the dose is compressed in a container, after compression the dose of substance is released;
 - it is necessary to perfectly coordinate the breath with the application of the substance;
 - children under the age of five are not able to perform the application themselves;

- the inhale must be slow, after the beginning of the inhale we press, after the end of the inhale we hold our breath for 5-10 seconds;
- the most common mistakes – not shaking, quick inhalation, late injection;
- inhalation attachments - to facilitate administration, in small children;
- breath-activated aerosol inhalers – inhalation does not require coordination with the breath;
 - there is a spring in the system that releases the required dose when inhaled;
- powder forms of antiasthmatics – they were developed so that freon propellant gases are not used and inhalation is easier;
 - all are triggered by inspiration;
 - the oldest was the Spinhaler, where the capsule (Intal) was inserted, it pierced and the powder was inhaled into the lungs;
 - Turbuhaler – drug container on a rotating disc, measures the dose;
 - Easyhaler etc.
- nebulizers – solution forms of bronchodilators, the drug is either dissolved in a liquid (solutions) or dispersed in it (suspension) from which an aerosol is then formed – either by ultrasound or jet.



An example of an inhaler

Corticosteroids systemically

- acute exacerbation of asthma – we give prednisone for 3-7 days;
 - maintenance long-term treatment of persistent asthma - only in the most severe forms;
- acute exacerbation – even methylprednisone or hydrocortisone.

Treatment of asthma exacerbation

Exacerbation of asthma

- Progressive worsening of shortness of breath, cough, wheezing, chest tightness, or a combination of these symptoms;
- the preschool child finds a sitting position, speaks in shorter sentences, takes a breath while speaking;
- symptoms worsen with movement;
- a severe state of acute asthma - associated with a general alteration, a small child is restless, an infant or toddler does not want to drink, is exhausted, an older child is bent forward, speaks jerkily, wheezing turns into quiet breathing.

Treatment

- **Inhalation of beta-2-agonists with a rapid onset of effect ev. + anticholinergics** ; It is appropriate to use a professional or improvised tool - **a spacer**. A tachypneic respiratory patient inhales undispersed medication only superficially (he is unable to coordinate inhalation).
 - + **corticosteroids after**;
 - + **oxygen inhalation during hypoxia** ;
- in an acute state **we do not administer**: inhaled corticoids, oral β_2 -agonists, oral theophyllines, antihistamines, sedatives, mucolytics, antibiotics!!!



Asthma spacer

Links

Related Articles

- Acute bronchitis
- Obstructive bronchitis
- Recurrent bronchitis
- Bronchiolitis
- Asthma bronchiale/case report
- Bronchial asthma therapy

External links

- Illustrative video from Osmosis: Asthma - clinical presentation (https://www.youtube.com/watch?v=gvxF_TJhHiA)
- Acute asthma – interactive algorithm + test (<https://www.akutne.cz/algorithm/cs/181--/>)
- Post-exercise bronchospasm (<https://mefanet.lfp.cuni.cz/clanky.php?aid=64>)

Reference

- PETER, Vít. *What do we know about childhood asthma? : Pediatrics for Practice* [online] . - edition. 2009. 148-152 pp. Available from <<http://www.pediatricpropraxi.cz/artkey/ped-200803-0002.php>>. ISBN 1803-5264.
 - KLOZAR, Vít, et al. *Current trends in the treatment of childhood asthma : Pediatrics for Practice* [online] . - edition. 2007. 216-219 pp. Available from <<http://www.pediatricpropraxi.cz/artkey/ped-200704-0005.php>>. ISBN 1803-5264.
 - MÁČEK, Miloš and Jiří RADVANSKÝ, et al. *Physiology and clinical aspects of physical activity*. 1. edition. 2010. 300 pp. ISBN 9788072626953.
1. PETRŮ, Vít. Co víme o dětském astmatu?. *Pediatric pro praxi* [online]. 2008, y. 9, p. 148-152, Available from <<http://www.pediatricpropraxi.cz/artkey/ped-200803-0002.php>>. ISSN 1803-5264.
 2. PETRŮ, Vít. Aktuální trendy v léčbě dětského astmatu. *Pediatric pro praxi* [online]. 2007, y. 8, p. 216-219, Available from <<http://www.pediatricpropraxi.cz/artkey/ped-200704-0005.php>>. ISSN 1803-5264.
 3. MÁČEK, Miloš – RADVANSKÝ, Jiří. *Fyziologie a klinické aspekty pohybové aktivity*. 1. edition. Galén, 2010. 300 pp. ISBN 9788072626953.