Nuoto ed asma

Alessandro Fiocchi

Presidente Società
Italiana di Pediatria
Sezione Lombarda

7 settembre 2011

Nuoto ed asma

- Asma e nuoto
- Epidemiologia
- Disinfezione
- Esposizione acuta
- Dati negli atleti
- Dati nei bambini
- Meccanismi di azione
- Possibilità di intervento
- Impatto globale sulla salute
- Conclusioni

Thorax, 1979, **34**, 682–683

"Coughing water": bronchial hyperreactivity induced by swimming in a chlorinated pool

C P MUSTCHIN AND C A C PICKERING

From the Chest Clinic, Wythenshawe Hospital, Manchester, UK

The children told us that different pools at times smell unusually strongly of "chlorine," and cause chest discomfort with cough after an hour or more spent swimming... They are colloquially known as being due to "coughing water." These symptoms typically follow prolonged periods of vigorous swimming, when inevitably large volumes of air including gaseous chlorine liberated at the water's surface are inhaled

....it is pertinent that for many known asthmatic patients swimming is a form of exercise that is recommended above others because of a possibly lesser tendency to cause exercise-induced symptoms. Possibly many asthmatic subjects have experienced effects from bathing in chlorinated water, and the symptom of "coughing water" might be sought when interviewing these patients.

Swimming and asthma

- Swimming ranks high among preferred types of physical activity in both children and adults
- Availability of swimming pools ⇨ higher levels of physical activity in the general population.
- Injuries
- Infections
- Swimming and asthma?

World Health Organization. Guidelines for safe recreational water Environments. Volume 2. Swimming pools and similar environments. World Health Organization, Geneva, 2006.

Goodman M. Asthma and Swimming: A Meta-Analysis. J. Asthma 2008;45:639–47

Nuoto ed asma

- Asma e nuoto
- Epidemiologia
- Disinfezione
- Esposizione acuta
- Dati negli atleti
- Dati nei bambini
- Meccanismi di azione
- Possibilità di intervento
- Impatto globale sulla salute
- Conclusioni

Swimming and asthma - epidemiology

- Belgium - ⇧ risk of childhood asthma vs indoor & outdoor swimming pool attendance
- Ireland - ⇧ risk of asthma vs # of years/pools

Bernard A, Nickmilder M, Voisin C, Sardella A. Impact of chlorinated swimming pool attendance on the respiratory health of adolescents. Pediatrics 2009;124:1110–111

Cotter A, Ryan CA. The pool chlorine hypothesis and asthma among boys. Ir Med J 2009;102:79–82

Swimming and asthma - epidemiology

- No such findings:

- Germany
- Italy
- Spain

Kohlhammer Y. Swimming pool attendance and hay fever rates later in life. Allergy 2006;61:1305–9

Schoefer Y. Health risks of early swimming pool attendance. Int J Hyg Environ Health 2008;211: 367–73

Carraro S. Swimming pool attendance and exhaled nitric oxide in children. J Allergy Clin Immunol 2006;118:958–60

Font-Ribera L. Swimming pool attendance and risk of asthma and allergic symptoms in children. Eur Respir J 2009;34:1304–10

Swimming and asthma

I – asthma in elite swimmers vs other elite athletes

II – asthma vs swimming pool attendance during childhood

III – swimming training programs vs asthma severity /pul-monary function

IV – immediate respiratory effects of swimming among asthmatics vs those of other types of exercise.

Goodman M. Asthma and Swimming: A Meta-Analysis. J. Asthma 2008;45:639–47

III -Swimming training programs vs asthma severity /pulmonary function

- Swimmers' asthma severity improve 42-46% more than controls

Goodman M. Asthma and Swimming: A Meta-Analysis. J. Asthma 2008;45:639–47

III -Swimming training programs vs asthma severity /pulmonary function

TABLE 5.—Summary of Group III studies evaluating the effect of swimming training programs on respiratory function and disease severity among asthma patients.

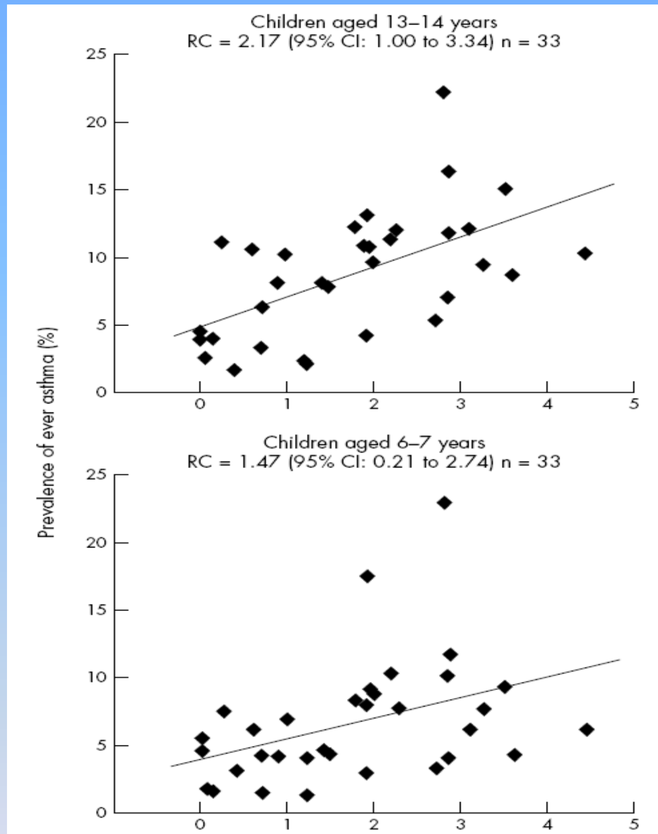
Authors (reference)	Quality Score	Participants, Location	Intervention	Control	Endpoints (% change in swimmers)	Difference between groups (95% CI)
Sly et al. 1972 (50)	7	12 children, age 9–12, New Orleans, US	Swimming & other exercise for 3-months	No exercise (N = 12, age 9–13)	Frequency of wheezing (49.8) FEV_1 at rest (14.3)	52.8 (−12.6, 118.2) 7.3 (−10.3, 25.0)
Fitch 1977 (52)	5	32 children, age 9–16, Perth Australia	Swimming training at least 50 km in 5 mo.	Swimming <50 km in 5 months (N = 14, age NS)	Asthma severity score (51.2)	37.0 (0.0, 74.0)*
Schnall et al. 1982 (53)	4	11 children, mean age 9.2, Parkville, Australia	Swimming pool program for 10 weeks	Dry land exercise, (N = 12, mean age 9.7)	Asthma severity score (43.7) FEV_1 at rest (−5.6) Post-exercise fall in PEF (2.5)	43.7 (−68.2, 155.6)* 6.2 (−136.8, 149.2) 2.0 (−19.1, 23.1)
Svenonius et al. 1983 (49)	5	15 children, age 9–16, Malmö, Sweden	Swimming and other exercise, duration unclear	No exercise (N = 10, age 9–17)	FEV_1 at rest (2.1) Post-exercise fall in FEV_1 (8.8)	−0.1 (−24.2, 24.1) 5.2 (−4.8, 15.2)
Huang et al. 1989 (51)	7	45 children, age 6–12, Baltimore, US	Swimming pool lessons for 2 months	No exercise (N = 45) matched on age, sex & asthma severity	Frequency of asthma attacks (78)	67.0 (16.1, 117.9)*
Matsumoto et al. 1999 (36)	10	8 children, age 9–11, Fukuoka, Japan	Swimming program for six weeks	No exercise (N = 8, age 8–11)	Post-swimming fall in FEV_1 (6.6) Post-cycling fall in FEV_1 (22.6)	5.3 (−58.9, 69.5) 10.6 (−71.7, 93.0)
Weisgerber et al. 2003 (10)	6	5 children, age 7–12, Augusta, US	Swimming pool lessons for 5–6 weeks	No exercise (N = 3, age 7–8)	Asthma severity score (8.7) FEV_1 at rest (5.3)	21.0 (−32.1, 74.0) 2.2 (−15.5, 19.9)
Arandelovič et al. 2007 (48)	6	45 adults, (mean age 33.1), Niš, Serbia	Swimming program for 6 months	No exercise (n = 45, mean age 33.5	FEV_1 at rest (2.8)	1.6 (−11.5, 14.7)
META-ANALYSIS						
Studies (10, 50–53) evaluating effect of swimming training on clinical asthma severity, $P_{heterogeneity} = 0.79$						42.3% (19.0, 66.3); FSN = 18
Subset of studies with the highest score (10, 50, 51) evaluating effect of swimming training on clinical asthma severity; $P_{heterogeneity} = 0.46$						46.8% (14.8, 78.8)
Studies (10, 48–50, 53) evaluating effect of swimming training on FEV_1 at rest; $P_{heterogeneity} = 0.99$						2.9% (−5.6, 11.3)
Subset of studies with the highest score (10, 48, 50) evaluating effect of swimming training on FEV_1 at rest; $P_{heterogeneity} = 0.87$						3.2% (−5.8, 12.3)
Studies (36, 49, 53) evaluating effect of swimming training on post-exercise fall in PFTs; $P_{heterogeneity} = 0.45$						4.7% (−4.2, 13.6)

Confidence intervals approximated based on *p*-values reported by authors. FEV_1 = forced expiratory volume exhaled in 1 second; PEF = peak expiratory flow.

5:639–47

Impact of chlorinated swimming pool attendance on the respiratory health of adolescents

Among children aged 13–14 years, the prevalence of asthma across Europe increased respectively by 2.73% (95% CI 1.94 to 3.52), with an increase of one indoor chlorinated pool per 100 000 inhabitants.



Main messages

- The prevalences of childhood asthma and the number of indoor chlorinated swimming pools in Europe are linked through associations that are geographically consistent and independent of climate, altitude, and the socio-economic status of the country.
- The strongest associations were found with ever asthma, which was also the asthma outcome showing the strongest East–West gradient in Europe.
- These findings accord with the "pool chlorine" hypothesis postulating that the rise of childhood asthma could result, at least partly, from the increasing exposure of young children to chlorination products contaminating the air and water of indoor swimming pools.

Bernard A, Nickmilder M, Voisin C, Sardella A. Impact of chlorinated swimming pool attendance on the respiratory health of adolescents. Pediatrics. 2009 Oct;124(4):1110-8

- Asma e nuoto
- Epidemiologia
- Disinfezione
- Esposizione acuta
- Dati negli atleti
- Dati nei bambini
- Meccanismi di azione
- Possibilità di intervento
- Impatto globale sulla salute
- Conclusioni

Drowning in disinfection byproducts ?

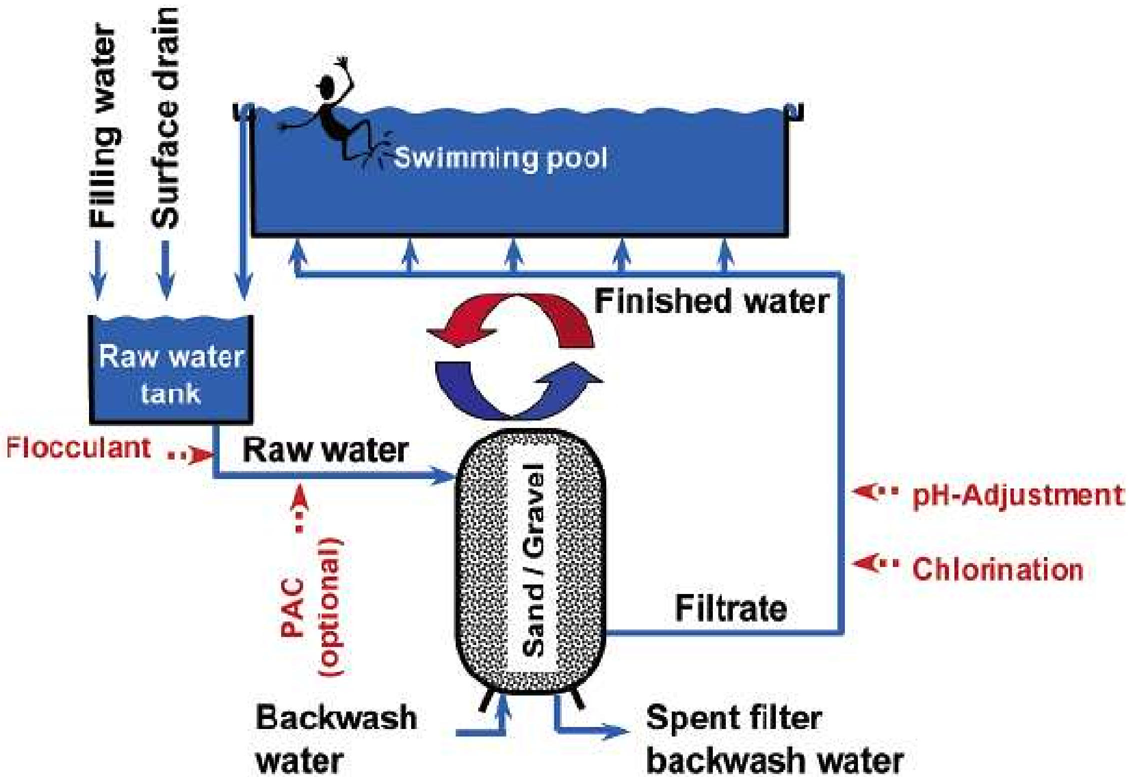


FIGURE 1. Scheme of conventional pool water treatment with flocculation – filtration – chlorination. PAC = powdered activated carbon (adapted from ref *15*).

- Zwiener C. Drowning in disinfection byproducts? Assessing swimming pool water. Environ Sci Technol. 2007;41:363-72

Tecniche di disinfezione

$Cl_2 + H_2O = HOCl + HCl$

The disinfectant used must have the potency to remove the indicator microorganism, *Pseudomonas aeruginosa*, by 99.99% within 30 seconds

- Flocculation used only in Germany
- Concentration:

-0,3-0,6 mg/L	Germany
-0,6-1,2 mg/L	Italy
-1-3 mg/L	USA, UK, Aus

Zwiener C. Drowning in disinfection byproducts? Assessing swimming pool water. Environ Sci Technol. 2007;41:363-72

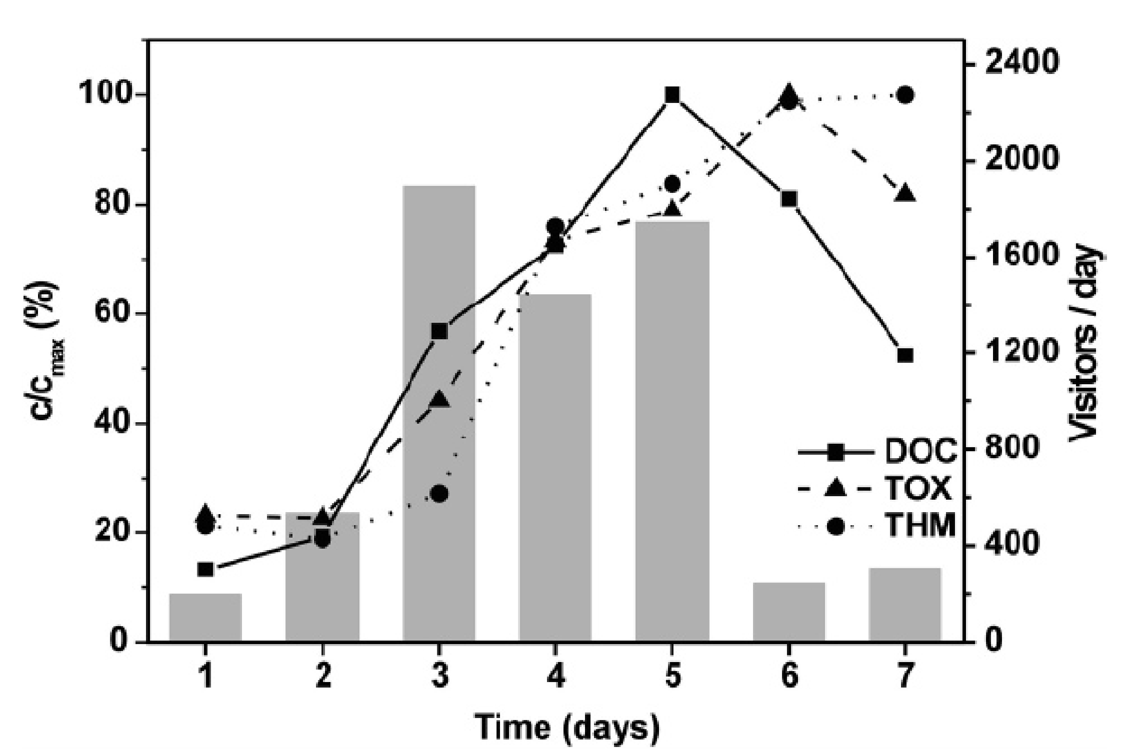
Quali sostanze ?

Table 2. Agents, including DBPs, in indoor pools and measurement methods for air and water and additional chemicals and biologics (and analytical methods) for which data are needed to fully understand the pool environment.

Chemical	Analytical method(s)
Primary agents	
Trichloramine (NCl_3)	Héry et al. (1995) method (nonspecific)
Dichloramine ($NHCl_2$)	DPD (nonspecific)
Monochloramine (NH_2Cl)	MIMS
	Small portable mass spectrometer
Free available chlorine (HOCl)	DPD
Chlorine gas (Cl_2)[a]	OSHA ID-101[b]
	NIOSH 6011[c]
Cyanogen chloride (CNCl)	GC-ECD GC/MS
Dichloromethylamine (CH_3NCl_2)	MIMS
Dichloroacetonitrile	
Dichlorooxide (Cl_2O)	High-resolution UV spectroscopy
Additional agents	
Volatile organic halogen (VOX)	P&T GC-ECD or GC-MS
Bromate (BrO_3^-)[d]	IC conductivity
Chlorate (ClO_3^-)[d]	IC-MS
Chlorite (ClO_2^-)[d]	
Cyanuric acid[d]	GC-ECD, GC/MS

Weisel CP. Childhood asthma and environmental exposures at swimming pools: state of the science and research recommendations. Environ Health Perspect. 2009;117:500-7.

Prodotti clorinati e frequentazione delle piscine



Accumulation of dissolved organic carbon (DOC)
Formation of total organic halide (TOX)
in a public outdoor pool with flocculation and filtration treatment.

Zwiener C. Drowning in disinfection byproducts? Assessing swimming pool water. Environ Sci Technol. 2007;41:363-72

Nuoto ed asma

- Asma e nuoto
- Epidemiologia
- Disinfezione
- Esposizione acuta
- Dati negli atleti
- Dati nei bambini
- Meccanismi di azione
- Possibilità di intervento
- Impatto globale sulla salute
- Conclusioni

Esposizione accidentale a vapori di cloro

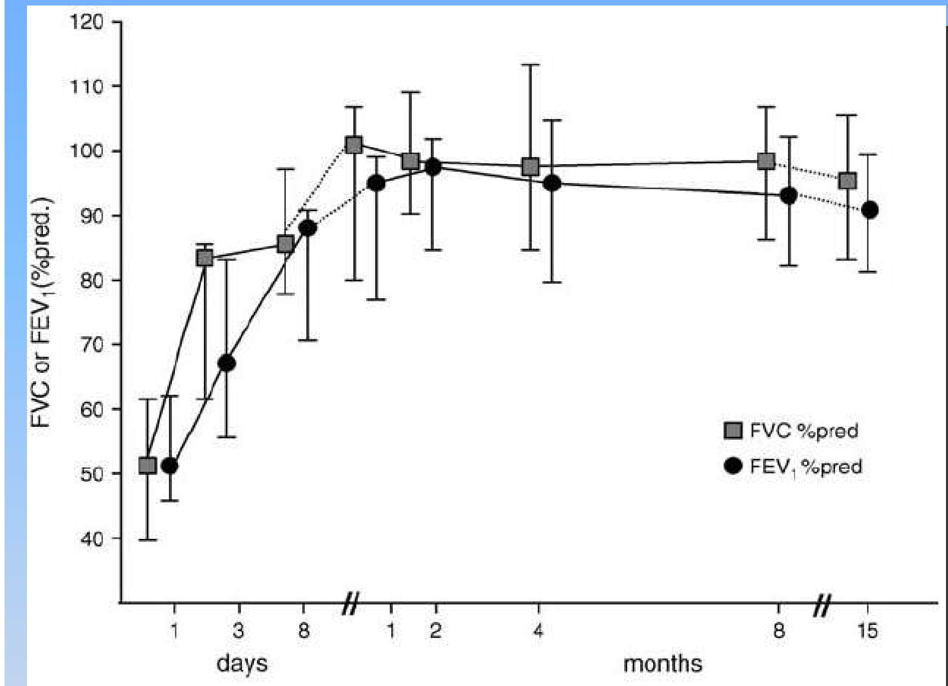
Among children, eye irritation occurred in 50.0%, nose and throat problems in 4.5%, any respiratory symptoms (shortness of breath,wheezing, cough) in 71.6%.

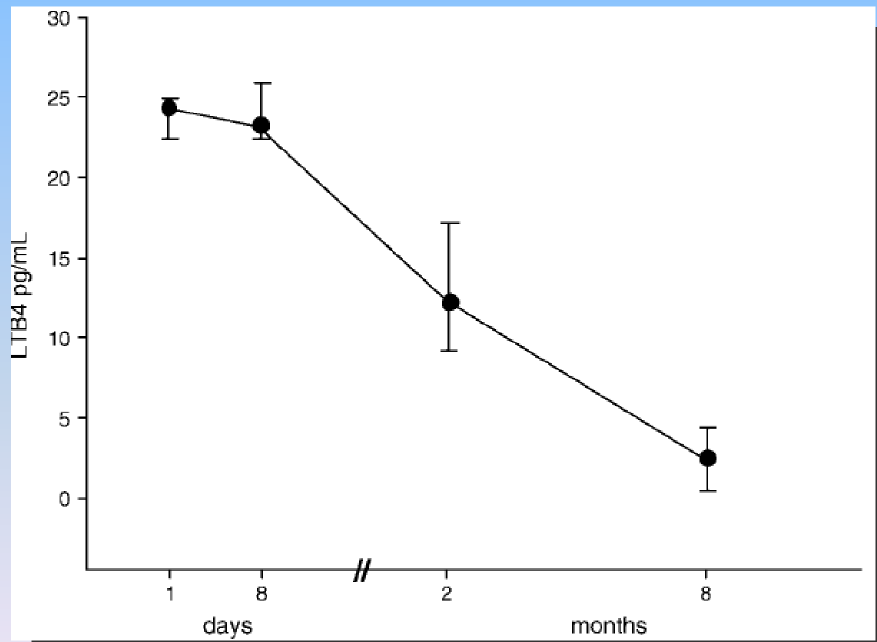
Table 4 Personal characteristics of children and adults who underwent clinical examination after 2 weeks and proportion (%) of respiratory symptoms at 15–30 days, Rome, 1998

	Respiratory symptoms† at 15–30 days					
	Children n=123		*Adults n=113*		*Total n=236*	
	n	*%*	*n*	*%*	*n*	*%*
Time to vacate the pool (minutes):						
<3	37	13.5	29	24.1	66	18.2
3–5	44	15.9	38	28.9	82	21.9
>5	31	41.9*	45	42.2	76	42.1*
Perception of exposure:						
Not at all/a little	73	12.3	54	25.9	127	18.1
A moderate amount	38	36.8	41	34.1	79	35.4
A lot	10	30.0*	18	50.0	28	42.9**

Agabiti N. Short-term respiratory effects of acute exposure to chlorine due to a swimming pool accident. Occup Environ Med 2001;58:399–404.

Chlorine, lung function impairment & biochemical exhaled breath alterations



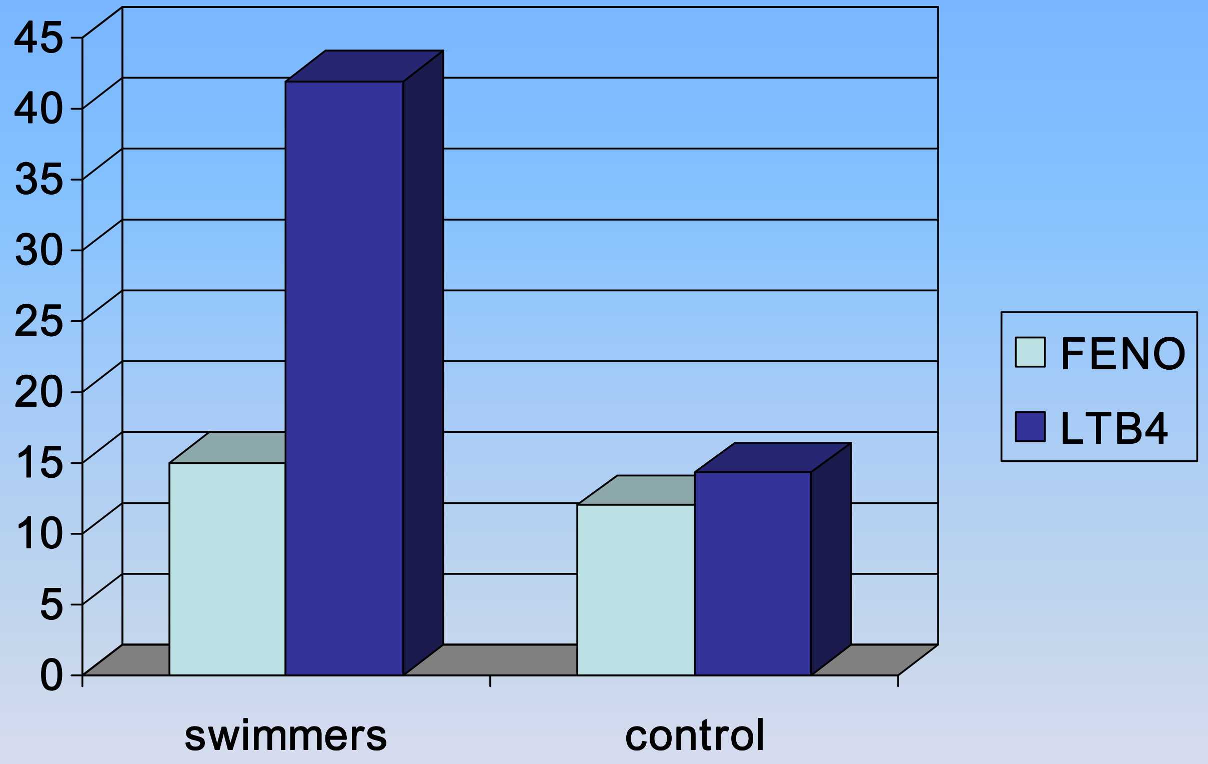


Bonetto G. Longitudinal monitoring of lung injury in children after acute chlorine exposure in a swimming pool. Am J Respir Crit Care Med. 2006;174:545-9.

Nuoto ed asma

- Asma e nuoto
- Epidemiologia
- Disinfezione
- Esposizione acuta
- Dati negli atleti
- Dati nei bambini
- Meccanismi di azione
- Possibilità di intervento
- Impatto globale sulla salute
- Conclusioni

Effects of chlorine derivatives in élite swimmers



Piacentini GL. Airway inflammation in elite swimmers.
J Allergy Clin Immunol. 2007;119:1559-60

I – asthma in elite swimmers vs other elite athletes

Asthma prevalence highest in swimmers

TABLE 3.—Summary of Group I observational studies evaluating the association between asthma diagnosis and swimming among elite athletes.

Authors	Quality Score	Exposed group	Comparison group	OR (95% CI)
Weiler et al. 1998 (41)	4	54 U.S. Olympic swimmers	645 other Olympic athletes	2.27 (1.13, 4.35)*
Helenius et al. 1998 (38)	2	42 Finnish elite swimmers	120 runners and speed & power athletes	1.42 (0.49, 3.86)*
Langdeau et al. 2000 (42)	2	25 Canadian high level swimmers	75 other high-level athletes	0.38 (0.08, 1.80)*
Smith et al. 2002(40)	2	50 Irish college swimmers	203 other college athletes	3.25 (1.57, 6.62)*
Dickinson et al. 2005 (37)	5	41 British Olympic swimmers	233 other British Olympic athletes	3.32 (1.52, 7.08)*¶
Katelaris et al. 2006 (39)	4	Australian Olympic swimmers (N not reported)	Non-swimmers (N not reported)	2.50 (1.70, 3.80)
		META-ANALYSIS		
All studies combined ; $P_{heterogeneity} = 0.16$				2.29 (1.57, 3.34); FSN= 83
Subset of studies with the highest score (37, 39, 41); $P_{heterogeneity} = 0.74$				2.57 (1.87, 3.54)

*Unadjusted results calculated from data in tables.
¶Limited to data for the 2000 Olympic team in which presence of asthma was extracted from medical forms.

Goodman M. Asthma and Swimming: A Meta-Analysis. J. Asthma 2008;45:639–47

Factors who may decrease EIB/EIA

- Warm temperatures (34-37°C)
- High humidity (100%)
- Absence of allergens
- Low air pollution
- Short episodes of fast/slow running with brief rests
- Good control of underlying asthma and BHR
- Physical conditioning: warm-up and cool-down sessions
- No respiratory tract infections
- Short time since last exercise

Dryden DM. Exercise-induced bronchoconstriction and asthma.
Evid Rep Technol Assess 2010;189:1-154.

Factors who may increase EIB/EIA

- Cold temperatures, dry air
- Airborne pollutants, allergens, moulds, dust Irritants
- Chlorine
- Continuous activities at near maximum aerobic capacity
- Poor control of underlying asthma and BHR
- Sudden burst of activity, fatigue, emotional stress, athletic ovetraining
- Sinusitis, viral rhinitis
- Pre-exercise foods eaten

Dryden DM. Exercise-induced bronchoconstriction and asthma.
Evid Rep Technol Assess 2010;189:1-154.

IV- Asthmagenicity of Swimming and Dry Land Exercises

Running and/or cycling 4- to 6-fold more asthmogenic than swimming

TABLE 6.—Summary of Group IV experimental studies comparing post-exercise effects of swimming to those of running and cycling among asthma patients.

Authors (reference)	Quality Score	Participants, Location	Endpoints (% change after swimming)	Comparison exercise	Difference between exercises (95% CI)
Fitch & Morton 1971 (33)	10	40 children & adults age 10–51, Perth, Australia	Post-exercise change in FEV_1 (−20.2)	Running Cycling	14.5% (3.5, 25.5) 10.7% (2.6, 18.8)
Godfrey et al. 1973 (57)	3	10 children & young adults, age not specified, London, UK	Post-exercise change in PEF (−14.7)	Running (N = 100) Cycling (N = 16)	26.6 (13.5, 39.7) 8.7% (−5.3, 22.7)
Bar-Yishai et al. 1982 (54)	9	13 children, age 9–17, Jerusalem Israel	Post-exercise change in FEV_1 (−13.0)	Running	19.2% (−4.3, 42.7)
Bundgaard et al. 1982 (56)	8	11 adults, age 17–46, Copenhagen, Denmark	Post-exercise change in PEF (−28.7)	Cycling	1.6% (−7.3, 10.5)
Reggiani et al. 1988 (55)	9	9 children, average age 15.1 years, Genoa, Italy	Post-exercise fall in FEV_1 (0.0)	Running Cycling	23.2% (6.0, 40.5) 14.4% (−0.1, 29.1)
Matsumoto et al. 1999 (36)	10	8 children, age 9–11, Fukuoka, Japan	Post-exercise fall in FEV_1 (−14.6)	Cycling	24.1% (2.7, 56.5)
META-ANALYSIS					
All studies comparing swimming to all other exercises combined; $P_{heterogeneity} = 0.12$					12.9% (6.2, 19.7); FSN = 61
Subset of studies with the highest score (33, 36, 54, 55) comparing swimming to all other exercises combined; $P_{heterogeneity} = 0.73$					14.4% (8.8, 20.0)
Studies comparing swimming to running (33, 54, 55, 57); $P_{heterogeneity} = 0.56$					20.1% (12.9, 27.3); FSN= 43
Subset of studies with the highest score (33, 54, 55) comparing swimming to running; $P_{heterogeneity} = 0.69$					17.3% (8.7, 25.9)
Studies comparing swimming to cycling (33, 36, 55–57); $P_{heterogeneity} = 0.39$					8.3% (3.0, 13.5); FSN= 11
Subset of studies with the highest score (33, 36, 55) comparing swimming to cycling; $P_{heterogeneity} = 0.69$					12.2% (5.2, 19.1)

Goodman M. Asthma and Swimming: A Meta-Analysis. J. Asthma 2008;45:639–47

Recommended Activities

- Baseball
- Downhill skiing
- Golf
- Some track and field events
- Swimming
- Tennis
- Volleyball
- Wrestling

Asthma and Allergy Foundation of America

Exercise-induced asthma in different sports

- High level endurance training in sports may increase BHR:
  - cross-country skiing
  - soccer
  - long distance running.

- Exposure to cold air, inhaled irritants, allergens.

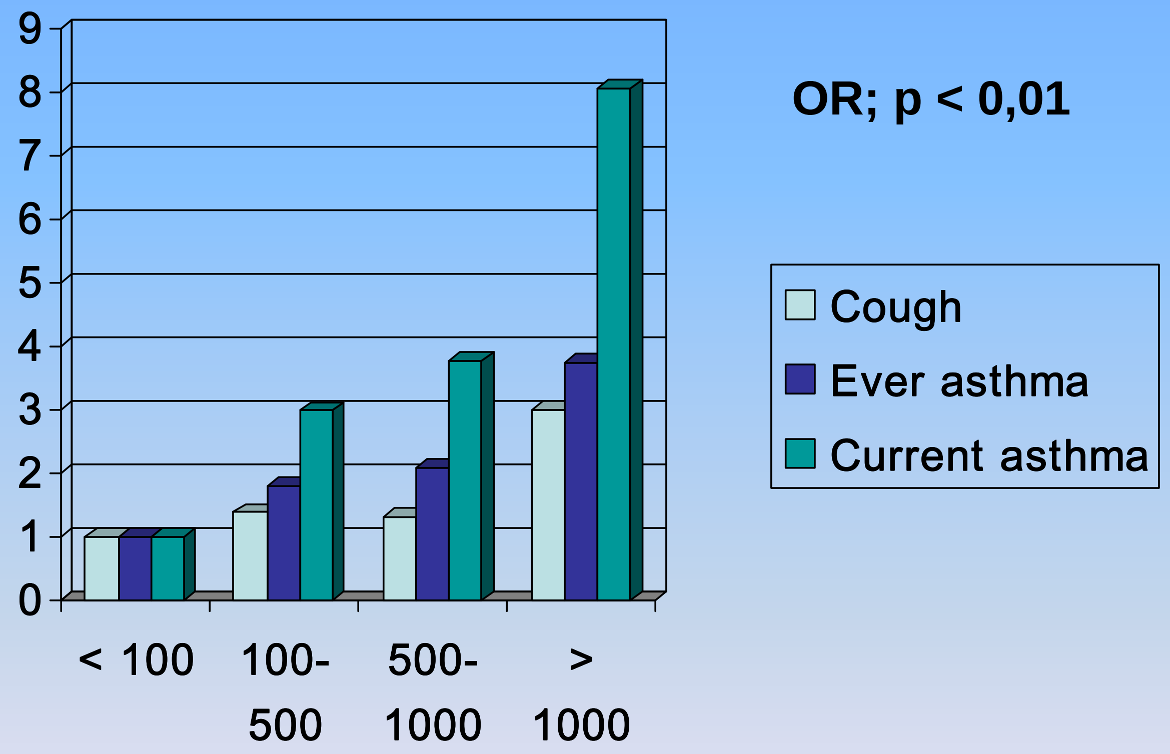
Bjermer L,. Bronchial hyperresponsiveness in athletes: mechanisms for development. In: Carlsen K-H, Delgado L, Del Giacco S, eds. Diagnosis, prevention and treatment of exercise-related asthma, respiratory and allergic disorders in sports. Wakefield, UK: European Respiratory Society Journals Ltd; 2005:19-34.

Price B. The asthma Rundell KW JD. Exercise-induced bronchospasm in the elite athlete. Sports Med 2002;32:583-600

Nuoto ed asma

- Asma e nuoto
- Epidemiologia
- Disinfezione
- Esposizione acuta
- Dati negli atleti
- Dati nei bambini
- Meccanismi di azione
- Possibilità di intervento
- Impatto globale sulla salute
- Conclusioni

Outdoor chlorinated swimming pool & asthma



OR; p < 0,01

Bernard A. Impact of chlorinated swimming pool attendance on the respiratory health of adolescents. Pediatrics. 2009;124:1110-8

Outdoor chlorinated swimming pool attendance is associated with higher risks of asthma, airways inflammation and some respiratory allergies

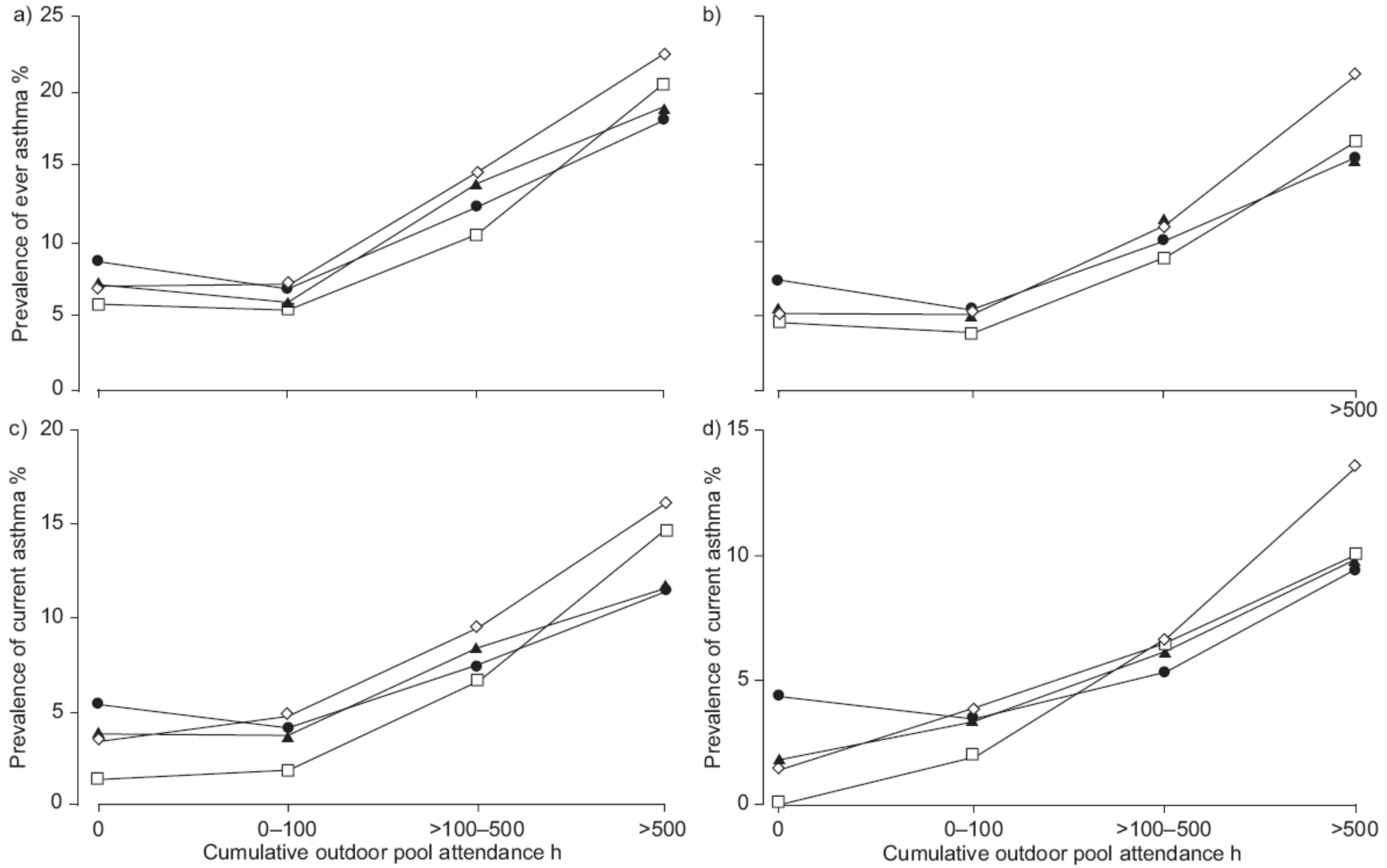


FIGURE 1. Prevalence of ever asthma and current asthma in all adolescents (a and c) and in those without parental asthma (b and d) according to their lifetime attendance of outdoor chlorinated swimming pools, considering either all subjects (●) or subjects with cumulative indoor pool attendance lower than 100 (□), 250 (◇) and 500 h (▲). The numbers of subjects in these four categories were respectively 847, 235, 410 and 633 in a) and c) and 734, 211, 357 and 547 in b) and d). p-values correspond to the Chi-squared test for trend. a) ●, ◇ and ▲: $p<0.001$; □: $p=0.01$. b) ●: $p=0.01$; □: $p=0.015$; ◇ and ▲: $p<0.001$. c) ●: $p=0.01$; □: $p=0.001$; ◇: $p<0.001$; ▲: $p=0.005$. d) ●: $p=0.03$; □: $p=0.015$; ◇: $p<0.001$; ▲: $p=0.005$.

Bernard A. Outdoor swimming pools and the risks of asthma and allergies during adolescence. Eur Respir J. 2008;32:979-88

Outdoor chlorinated swimming pool attendance is associated with higher risks of asthma, airways inflammation and some respiratory allergies

TABLE 5 Risks of asthma, increased exhaled nitric oxide and of sensitisation to aeroallergens associated with the attendance at a residential outdoor chlorinated swimming pool before the age of 7 yrs during a cumulative time of >50 h

	Residential outdoor pool attendance before the age of 7 yrs		OR (95% CI)			
	No	Yes	Unadjusted	p-value	Adjusted	p-value
Subjects n	804	43				
Any aeroallergen IgE[#]	292 (36.4)	23 (53.5)	2.01 (1.08–3.72)	0.03	2.20 (1.14–4.22)	0.02
House dust mite IgE	207 (25.9)	18 (41.9)	2.08 (1.11–3.88)	0.02	2.42 (1.26–4.64)	0.008
Cat IgE	97 (12.1)	10 (23.3)	2.20 (1.05–4.61)	0.04	2.57 (1.21–5.47)	0.014
Dog IgE	42 (5.2)	2 (4.7)	0.89 (0.21–3.78)	0.87	1.13 (0.26–4.92)	0.87
Mould IgE	1 (2.3)	23 (2.9)	0.81 (0.11–6.1)	0.84	1.09 (0.14–8.46)	0.93
Pollen IgE	169 (21.0)	7 (16.3)	0.73 (0.32–1.67)	0.46	0.82 (0.35–1.89)	0.63
Ever asthma[¶]	77 (9.6)	11 (25.6)	3.25 (1.57–6.70)	0.001	3.49 (1.61–7.57)	0.002
Current asthma[+]	48 (6.0)	7 (16.3)	3.06 (1.30–7.24)	0.01	2.98 (1.15–7.73)	0.025
Exhaled NO>30 ppb[§]	111 (13.8)	12 (27.9)	2.41 (1.20–4.84)	0.01	2.67 (1.28–5.55)	0.009

Bernard A. Outdoor swimming pools and the risks of asthma and allergies during adolescence. Eur Respir J. 2008;32:979-88

II – asthma vs swimming pool attendance during childhood

- Swimming pool attendance is not related to asthma prevalence

TABLE 4.—Summary of Group II observational studies evaluating the association between asthma diagnosis and swimming pool attendance during childhood.

Authors (reference)	Quality Score	Exposed group	Age range	Comparison group	OR (95% CI)
Bernard et al. 2006 (43)	3	157 Belgian children with >100 hr cumulative pool attendance (CPA), age 10–13	10–13	184 children with <100 hrs CPA	1.63 (0.75, 3.55)*
Carraro et al. 2006 (45)	2	100 Italian swimming pool (SP) attendees, age 7–10	7–10	141 non-SP children	0.54 (0.16, 1.54)**
Kohlhammer et al. 2006 (35)	6	1035 German adults who attended swimming pool at school age, age 35–74	35–74	274 persons who never attended pool at school age	0.89 (0.56, 1.41)
Levesque et al. 2006 (46)	5	305 Canadian swimmers, age <12–16+	<12–16+	499 soccer players	1.00 (0.60, 1.80)
Bernard et al. 2007 (44)	3	43 former swimming babies in Belgium, mean age 11.5	10–13	298 other children	2.20 (0.77, 6.50)
Schoefer et al. 2007 (34)	5	660 German children who attended pools since infancy followed from birth to age 6		191 children who started attending pool after age 3 or never	0.42 (0.22–0.82)
META-ANALYSIS					
All studies using results of Bernard et al. 2006; $P_{heterogeneity} = 0.09$					0.82 (0.54, 1.25)
All studies using results of Bernard et al. 2007; $P_{heterogeneity} = 0.09$					0.82 (0.52, 1.28)
Subset of studies with the highest score (34, 35, 46); $P_{heterogeneity} = 0.17$					0.63 (0.38, 1.06)

*Unadjusted results calculated from data reported in Table 1 and Figures 2 and 3 (published results use CPA as a continuous variable).
**Unadjusted results calculated from data provided by the authors (personal communication).

Goodman M. Asthma and Swimming: A Meta-Analysis. J. Asthma 2008;45:639–47

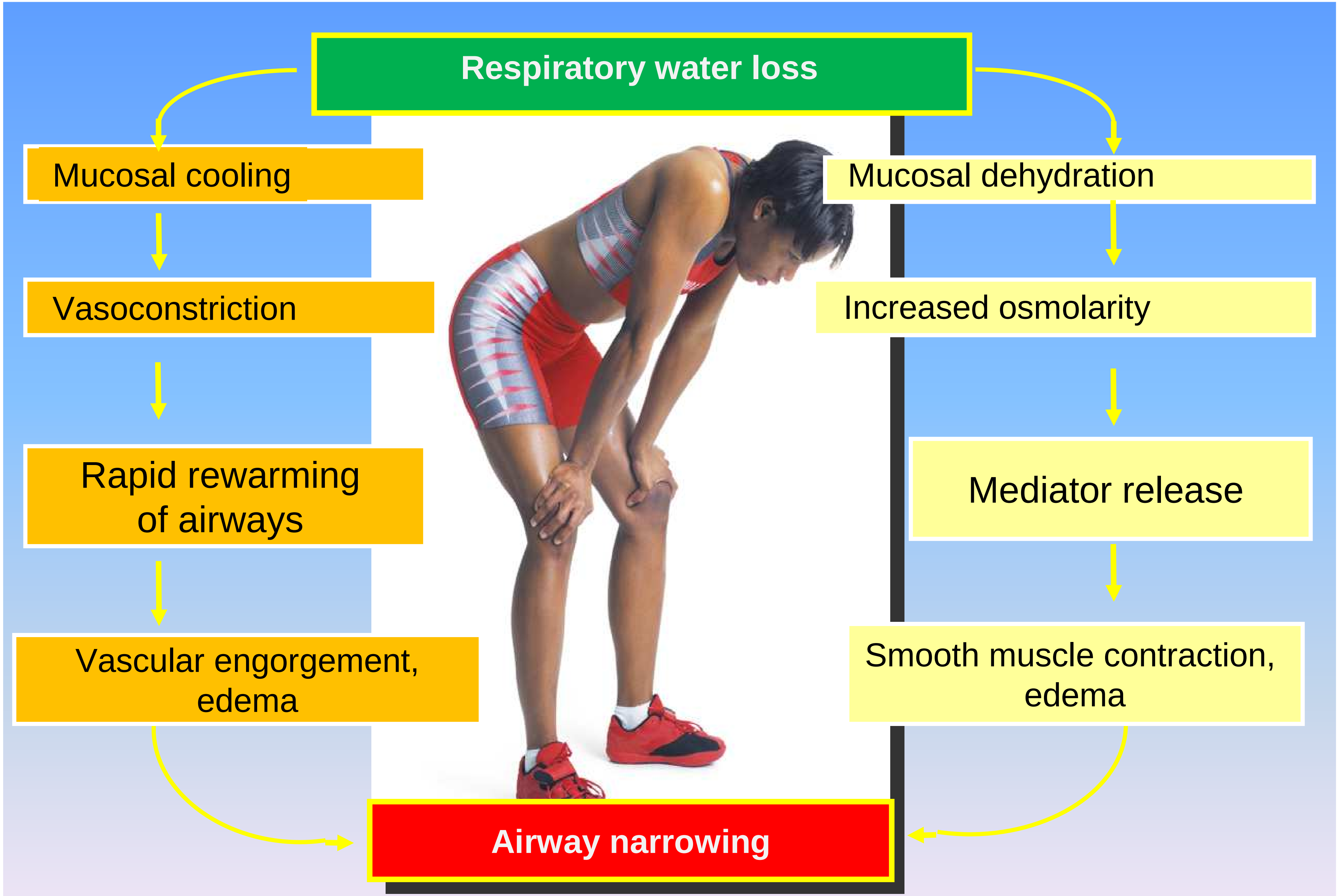
Nuoto ed asma

- Asma e nuoto
- Epidemiologia
- Disinfezione
- Esposizione acuta
- Dati negli atleti
- Dati nei bambini
- Meccanismi di azione
- Possibilità di intervento
- Impatto globale sulla salute
- Conclusioni

Exercise-induced asthma & sport

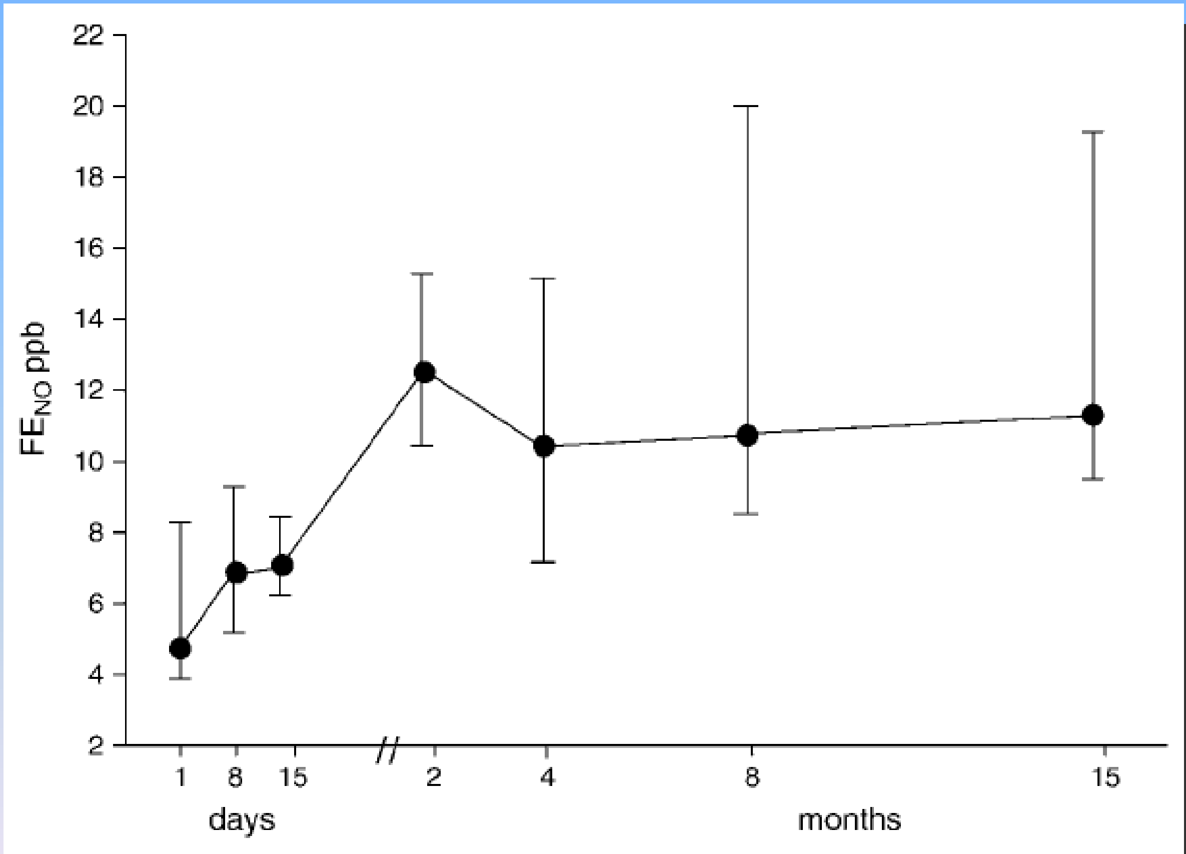
- ⇩ endurance despite conditioning
- ⇩ athletic performance
- ⇧ recovery time following exercise

Dryden DM. Exercise-induced bronchoconstriction and asthma.
Evid Rep Technol Assess 2010;189:1-154.



McFadden ER. Thermally induced asthma and airway drying. Am J Respir Crit Care Med 1999;160:221-6.

Chlorine, lung function impairment & biochemical exhaled breath alterations



The low FeNO levels observed after chlorine inhalation may be the consequence of massive epithelial destructionwith subsequent damage of NO-producing cells of the airway wall—that is, epithelial, endothelial, and nervous cells

Bonetto G. Longitudinal monitoring of lung injury in children after acute chlorine exposure in a swimming pool. Am J Respir Crit Care Med. 2006;174:545-9.

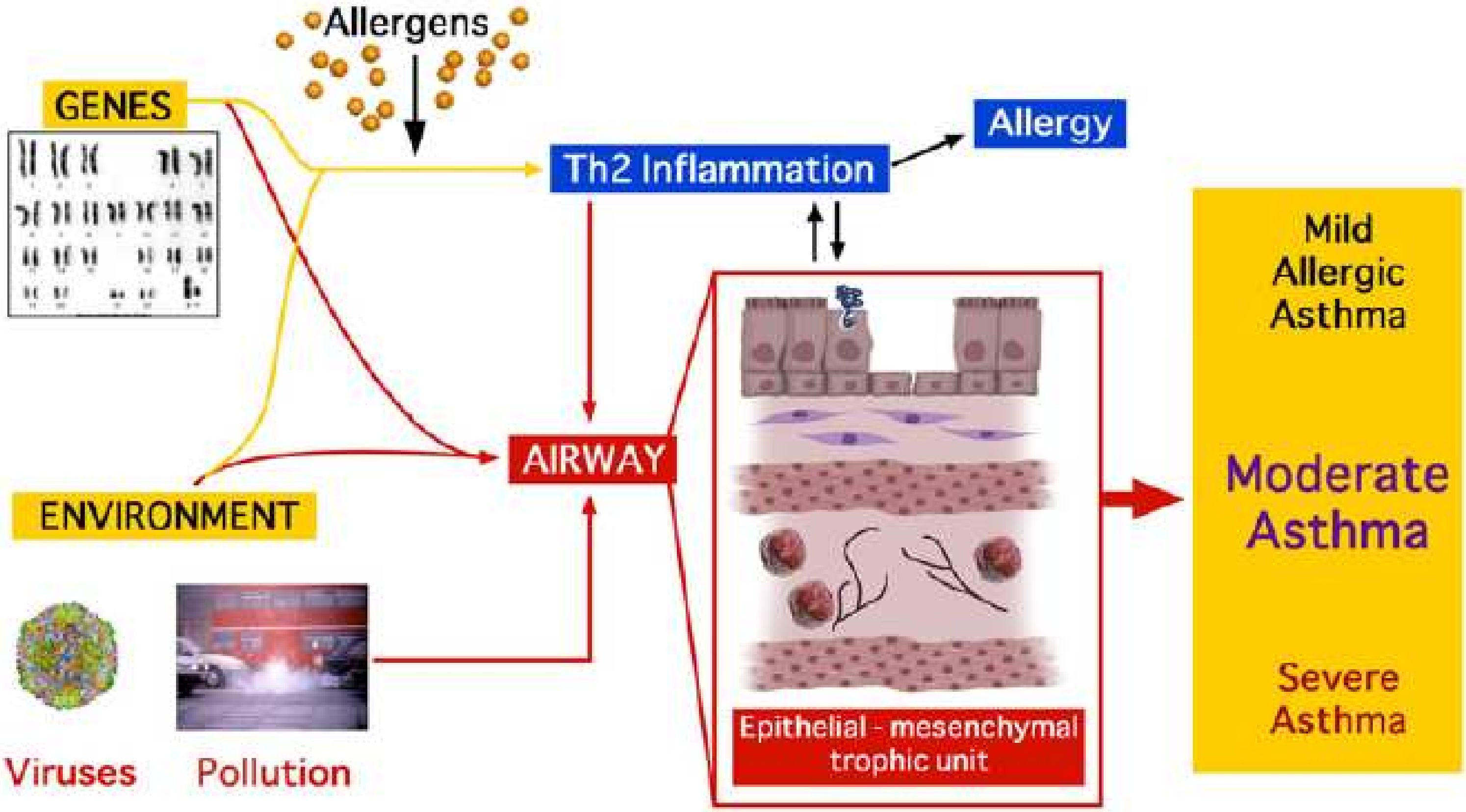
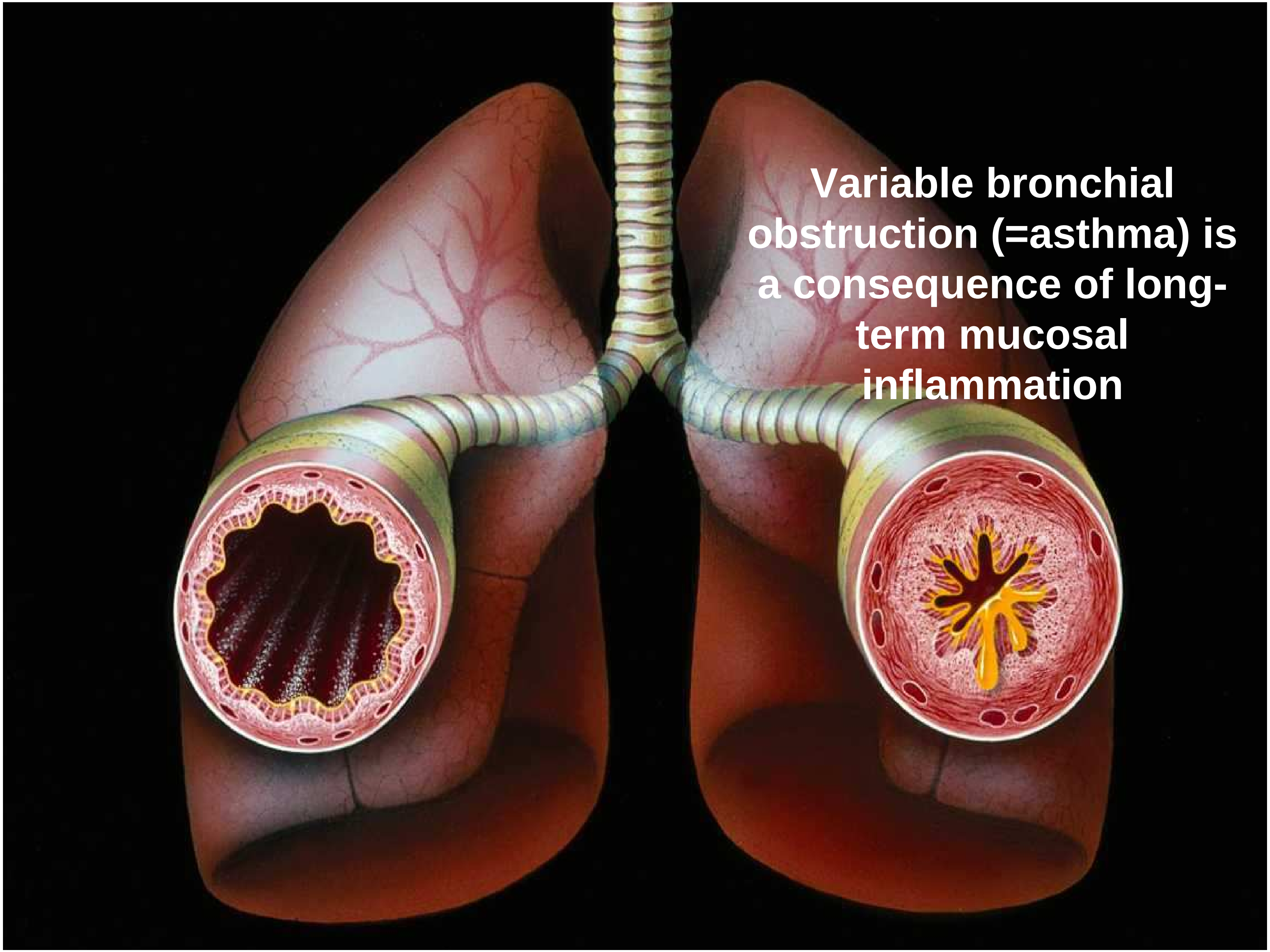


FIG 6. Schematic representation of the EMTU in providing epithelial interactions with the external environment and the T_H2 immune and inflammatory response to determine asthma phenotypes.

Holgate ST. The sentinel role of the airway epithelium in asthma pathogenesis. Immunol Rev. 2011;242:205-19


Variable bronchial obstruction (=asthma) is a consequence of long-term mucosal inflammation

Nuoto ed asma

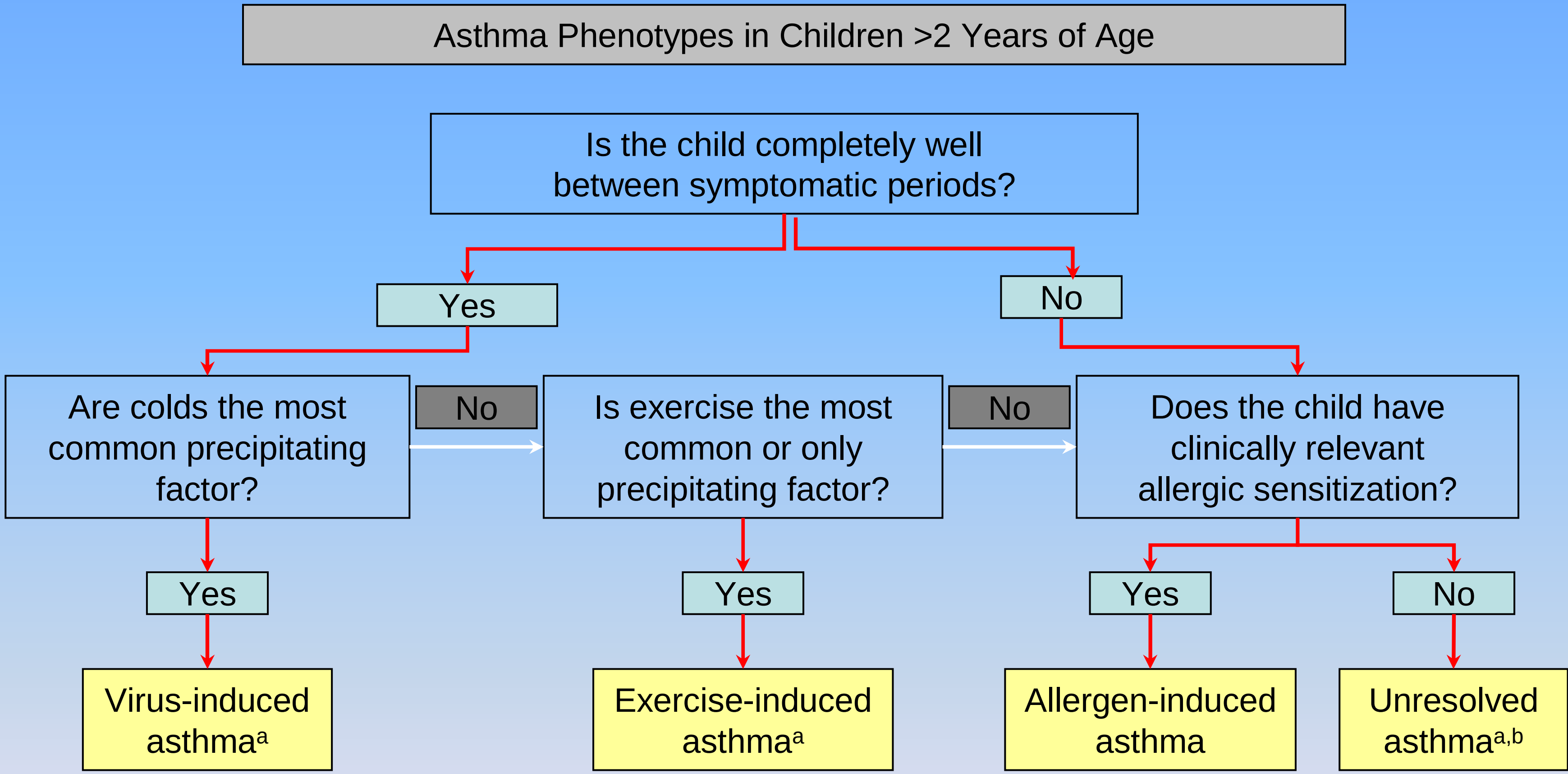
- Asma e nuoto
- Epidemiologia
- Disinfezione
- Esposizione acuta
- Dati negli atleti
- Dati nei bambini
- Meccanismi di azione
- Possibilità di intervento
- Impatto globale sulla salute
- Conclusioni

Warm-up and Cool-down Periods

- Help prevent asthma attacks
- Prevent the air in the lungs from quickly changing temperature
- Hydrate before, during and after exercise

Asthma and Allergy Foundation of America

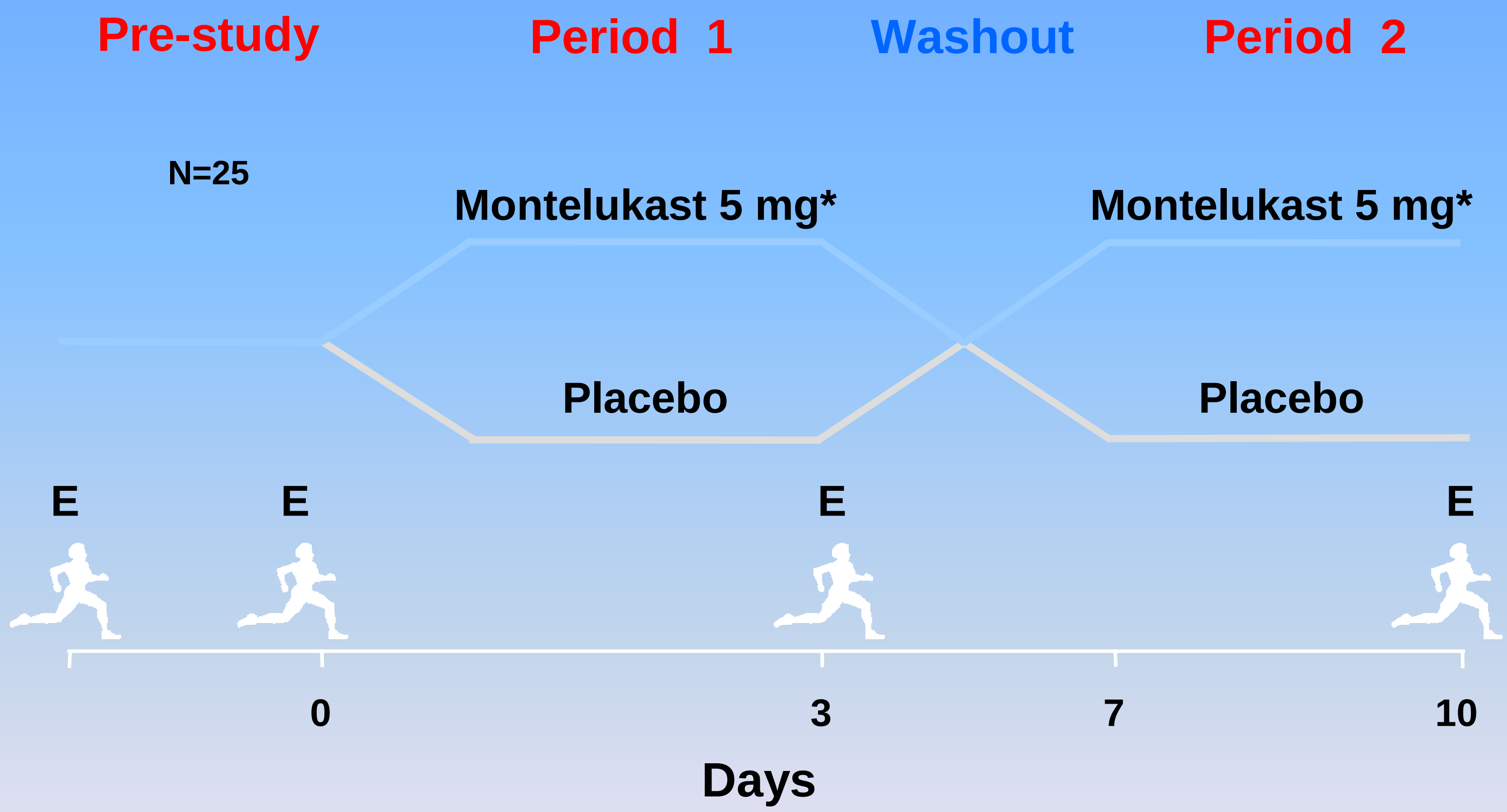
Identification of Asthma Phenotypes Is Critical



[a]Children may also be atopic.
[b]Different etiologies, including irritant exposure and as-yet not evident allergies, may be included here.

Adapted from Bacharier LB, et al. Allergy. 2008;63(1):5–34.

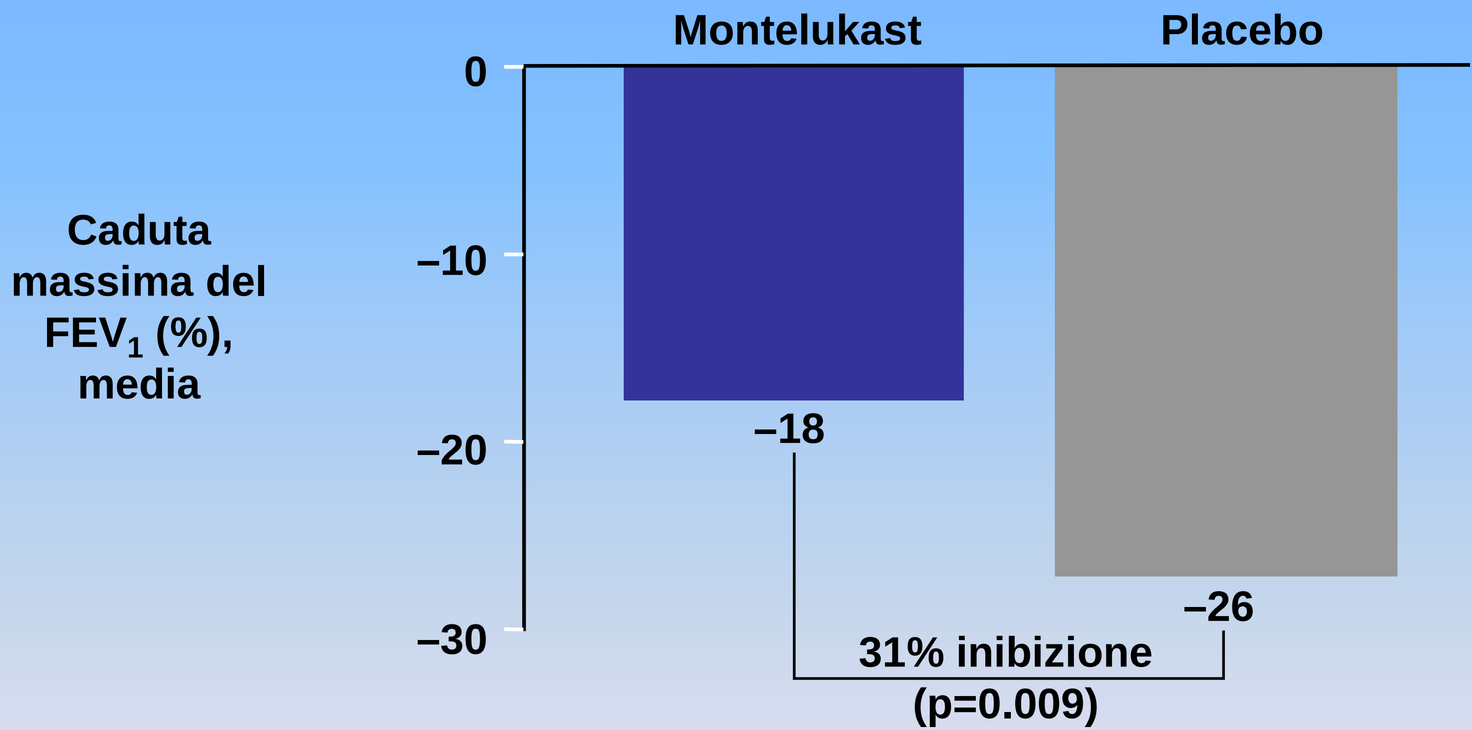
Montelukast once daily inhibits exercise-induced bronchoconstriction in 6- to 14-year-old children with asthma



Kemp JP. Montelukast once daily inhibits exercise-induced bronchoconstriction in 6- to 14-year-old children with asthma. J Pediatr. 1998;133:424-8

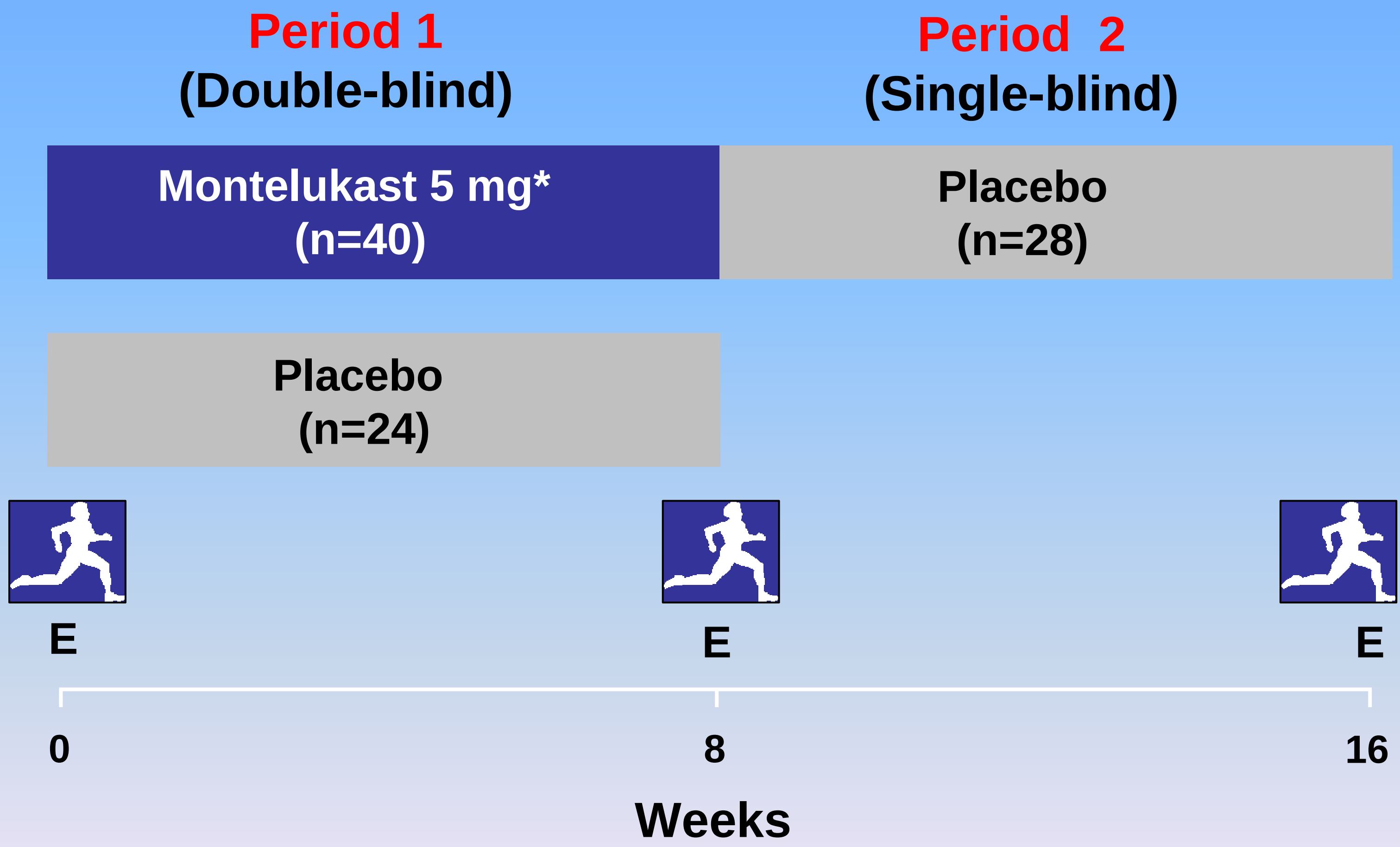
Montelukast riduce la caduta massima percentuale del FEV_1

N=25



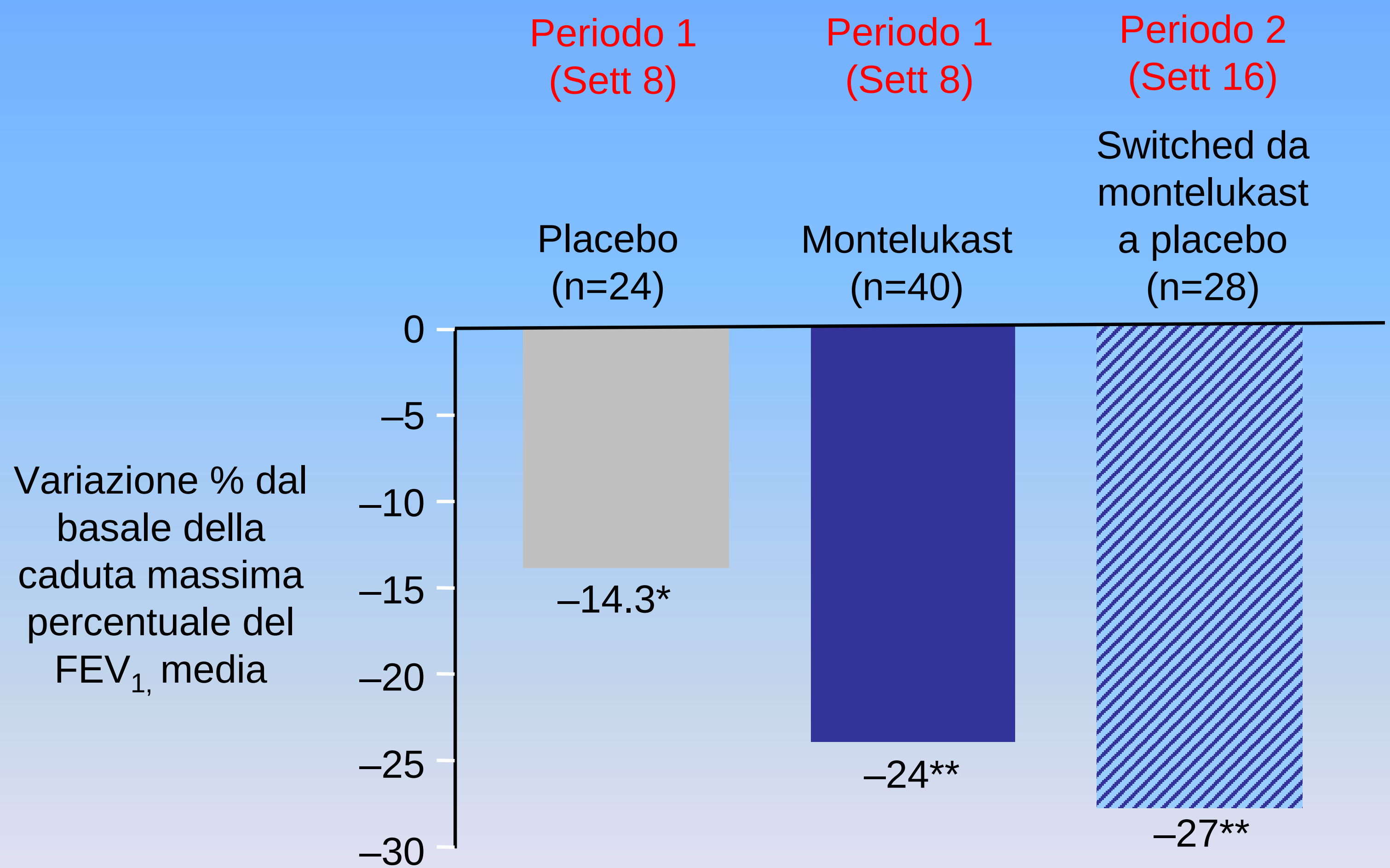
Kemp JP. Montelukast once daily inhibits exercise-induced bronchoconstriction in 6- to 14-year-old children with asthma. J Pediatr. 1998;133:424-8

Prolonged effect of montelukast in asthmatic children with exercise-induced bronchoconstriction



Kim JH. Prolonged effect of montelukast in asthmatic children with exercise-induced bronchoconstriction. Pediatr Pulmonol. 2005;39:162-6.

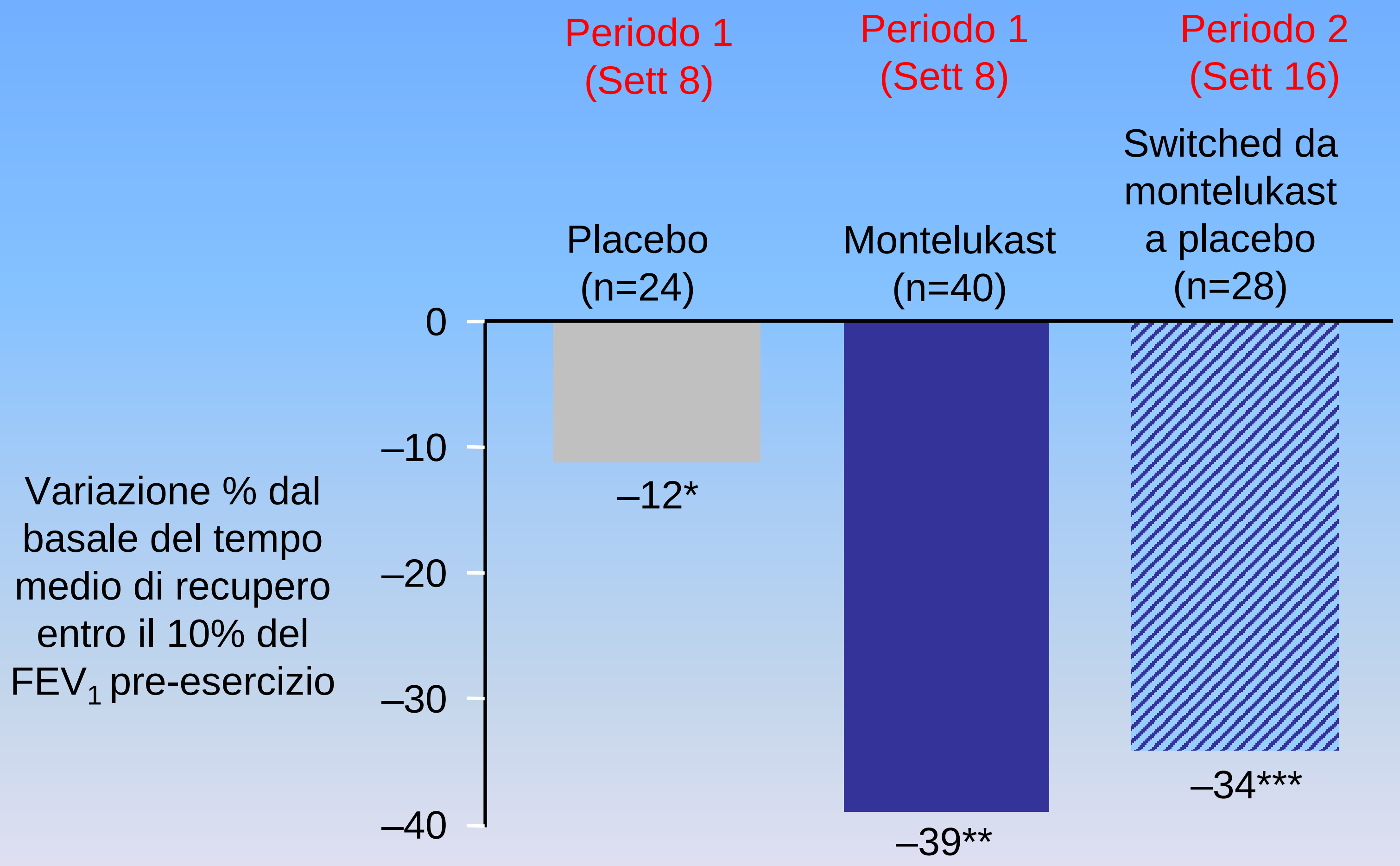
Montelukast riduce la caduta massima percentuale del FEV_1



*p = NS vs basale; **p<0.01 vs basale

Kim JH. Prolonged effect of montelukast in asthmatic children with exercise-induced bronchoconstriction. Pediatr Pulmonol. 2005;39:162-6.

Montelukast ruduce il tempo di recupero



*p = NS vs basale; **p<0.01 vs basale; ***p<0.05 vs basale

Kim JH. Prolonged effect of montelukast in asthmatic children with exercise-induced bronchoconstriction. Pediatr Pulmonol. 2005;39:162-6.

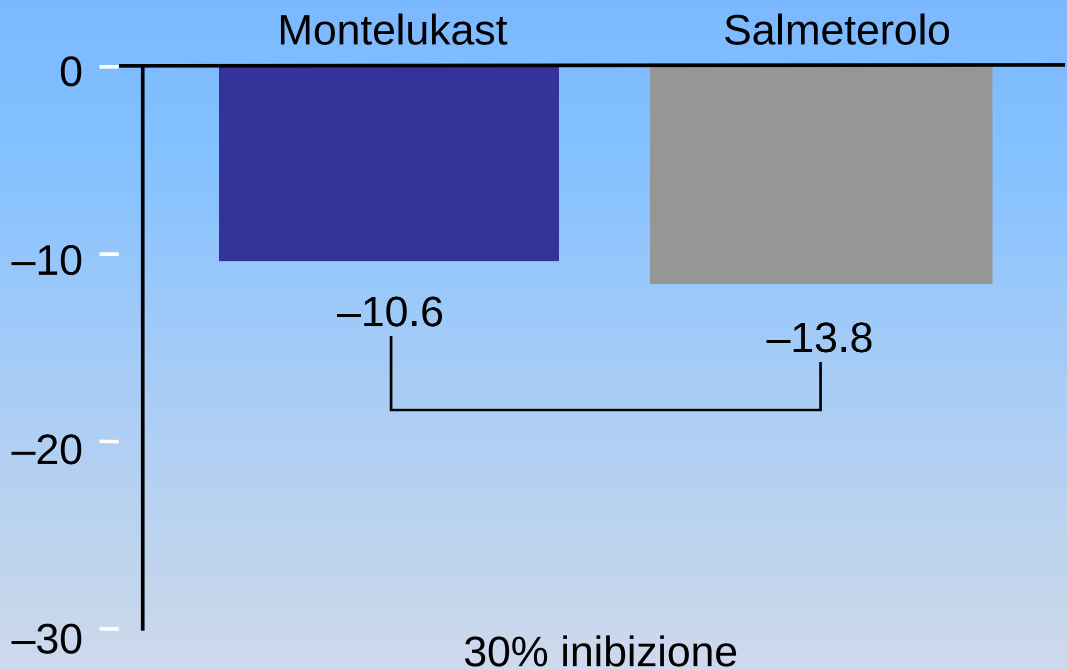
Montelukast vs. salmeterolo – asma da sforzo

N=153

Tutti in FP 100 mcg x 2

Gruppo A: + Salmeterolo 50 mcg x 2

Gruppo B: + MK, 5mg



30% inibizione (p=0.009)

Massimo decremento percentuale del FEV1 dopo esercizio e prima della prima dose di SABA

Fogel RB. Effect of montelukast or salmeterol added to inhaled fluticasone on exercise-induced bronchoconstriction in children Ann Allergy Asthma Immunol. 2010;104:511–7

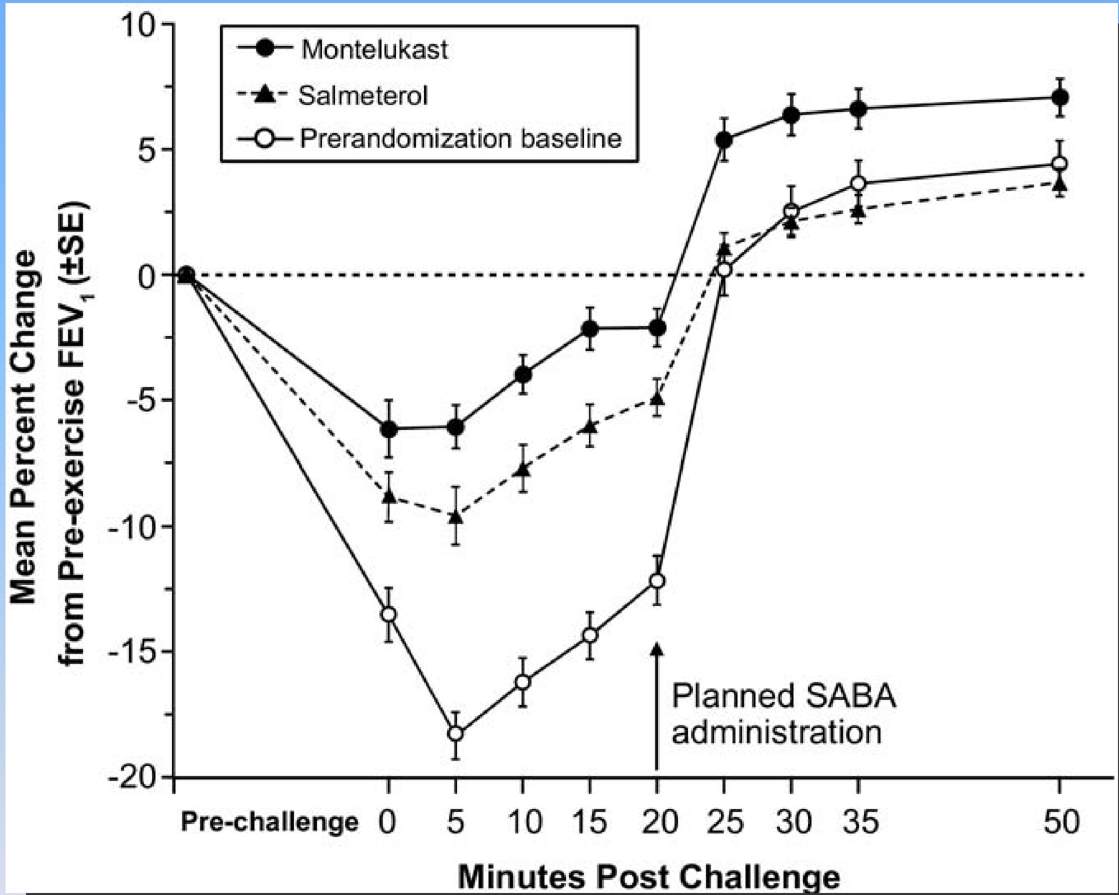
Montelukast vs. salmeterolo – asma da sforzo

N=153

Tutti in FP 100 mcg x 2

Gruppo A: + Salmeterolo 50 mcg x 2

Gruppo B: + MK, 5mg



Massimo decremento percentuale del FEV1 dopo esercizio e prima della prima dose di SABA

Fogel RB. Effect of montelukast or salmeterol added to inhaled fluticasone on exercise-induced bronchoconstriction in children Ann Allergy Asthma Immunol. 2010;104:511–7

Nuoto ed asma

- Asma e nuoto
- Epidemiologia
- Disinfezione
- Esposizione acuta
- Dati negli atleti
- Dati nei bambini
- Meccanismi di azione
- Possibilità di intervento
- Impatto globale sulla salute
- Conclusioni

There is inconsistent evidence from cross-sectional studies for an association between swimming pool attendance and the risk of asthma in childhood

5,700 children with prospectively collected data on swimming and respiratory symptoms and measurements

Font-Ribera L. Swimming pool attendance, asthma, allergies, and lung function in the Avon Longitudinal Study of Parents and Children cohort. Am J Respir Crit Care Med. 2011;183:582-8

At 7 years, > 50% swam once per week or more.

Swimming frequency vs. rhinitis, wheezing, asthma, eczema, hay fever, asthma medication: ns

Swimming frequency vs. rhinitis, wheezing, asthma, eczema, hay fever, asthma medication in atopics: ns

Font-Ribera L. Swimming pool attendance, asthma, allergies, and lung function in the Avon Longitudinal Study of Parents and Children cohort. Am J Respir Crit Care Med. 2011;183:582-8

Children with a high vs low cumulative swimming pool attendance from birth to 7 years:

OR 0.88 (95% CI 0.56–1.38) for ever asthma
OR 0.50 (95% CI 0.28–0.87) for current asthma at 7 years

Swimming associated with higher lung function and fewer respiratory symptoms, particularly among children with asthma

Font-Ribera L. Swimming pool attendance, asthma, allergies, and lung function in the Avon Longitudinal Study of Parents and Children cohort. Am J Respir Crit Care Med. 2011;183:582-8

Nuoto ed asma

- Asma e nuoto
- Epidemiologia
- Disinfezione
- Esposizione acuta
- Dati negli atleti
- Dati nei bambini
- Meccanismi di azione
- Possibilità di intervento
- Impatto globale sulla salute
- Conclusioni

Pediatric Pulmonology 44:31–37 (2009)

State of the Art

Swimming Pool, Respiratory Health, and Childhood Asthma: Should We Change Our Beliefs?

Z.S. Uyan, MD,[1] S. Carraro, MD,[1] G. Piacentini, MD,[2] and E. Baraldi, MD[1]*

"Meanwhile, the chlorine levels and temperature in swimming pools should be carefully regulated, indoor pools should be properly ventilated and bathers should be told about how good personal hygiene can reduce the irritant nature of swimming pool environments."

Nuoto ed asma

1. Nuoto sì
2. Attenzione alla qualità dell’aria
3. Attenzione alla qualità delle acque (UV?... Biguanidi?…)
4. PRACTALL!

Bacharier LB, Boner A, Carlsen KH, et al European pediatric asthma group. Diagnosis and treatment of asthma in childhood: a PRACTALL consensus report. Allergy2008;63:5–34.

Not everybody's cup of tea!

The 6th Milan International Meeting on Pediatric Allergy

WAO, ACAAI, AAAAI, EAACI

Milan, Thursday 9th – Sunday 12th February 2012