Name of research institute or organization:

Institute of Exercise and Health Sciences, University of Basel

Title of project:

Prevalence and pathophysiology of high altitude illness in children

Project leader and team:

PD Dr. med. Susi Kriemler, project leader
Prof. Dr. Med. Hanspeter Brunner, Birgit Soltermann, MSc, Christian Brunner, MSc

Project description:

Until recently, scarce data existed about the prevalence of high altitude illness in children in comparison to adults. We therefore performed a first study in 2006, in which we looked at differences in physiological or pathological adaptation to high altitude in 20 biological prepubertal children (mean age 11.9 years) and father pairs. We found that 1. the prevalence of acute mountain sickness (AMS) was similar in children and adults when measured with the standard Lake Louise score for adults, 2. children showed less sleep disturbances with less apneic events than adults, and 3. children showed significantly higher increases in pulmonary artery pressure on day 1 of high altitude exposure. Furthermore, the amount of pressure increase among children and their biological fathers was significantly related suggesting a genetic influence of the hypoxic pressure raise. This finding seems to be important since subjects that are at risk to develop a life threatening pulmonary edema under hypoxic conditions (=HAPE-susceptible individuals) show exaggerated pulmonary artery pressure increases at high altitude which is thought to be a main factor responsible for the development of the pulmonary edema. Based on these findings of the first study, we performed a second study in 2008, including 10 families with and without history of high altitude pulmonary edema (HAPE) with three major aims: To test 1. whether children of different maturity and age show the same prevalence of AMS with different questionnaires, including different children's versions. 2. whether HAPE susceptibility is genetically determined, and 3. to look at mechanisms responsible for the pulmonary artery pressure increase at high altitude. Preliminary results are the following:

1. The prevalence of AMS in prepubertal children, adolescents and adults are not different among fast ascent to high altitude. This finding was irrespective of questionnaire used (two adult or three children's versions). Nevertheless, every third child developed AMS during a period of two days at 3450m. The distribution of the AMS symptoms was also similar in children and adults. One 9-year-old girl developed severe AMS and had to be treated with dexamethason. The remaining 49 children responded well to symptomatic treatment of headache and gastrointestinal symptoms with paracetamol and/or antiemetics.
2. The pulmonary artery pressure increase on day 1 of altitude exposure was significantly higher in HAPE susceptible adults compared to non-HAPE susceptible adults, and all children. However, when gender specific analyses were done, boys of HAPE-susceptible fathers showed pulmonary artery pressures at high altitude that were not significantly different from the adult values, while this was not the case in girls. Based on the low numbers in each

group these finding are preliminary and have to be confirmed in a larger study. If true, these preliminary data suggest that the hereditary precondition of HAPE-susceptibility, i.e. an increased PAP response to acute hypoxia may be gender specific.

3. The third aim (to look at mechanisms of the pulmonary artery pressure raise at high altitude) has not been analysed yet.

Key words:

Children, high altitude, hypoxia, high altitude illness

Scientific publications and public outreach 2008:

Refereed journal articles and their internet access

Kriemler S, Kohler M, Zehnder M, Bloch KE, Brunner-La Rocca H. Successful treatment of severe acute mountain sickness and excessive pulmonary hypertension with dexamethasone in a prepubertal girl. *High Alt Med Biol* 2006; **7**: 256-61. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=16978138

Kriemler S, Jansen C, Linka A, Kessel-Schaefer A, Zehnder M, Schurmann T, et al. Higher pulmonary artery pressure in children than in adults upon fast ascent to high altitude. *Eur Respir J* 2008; **32**: 664-9.
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=18417505

Kohler M, Kriemler S, Wilhelm EM, Brunner-LaRocca H, Zehnder M, Bloch KE. Children at high altitude have less nocturnal periodic breathing than adults. *Eur Respir J* 2008; **32**: 189-97
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=18287125

Book sections

Kriemler, S. *Kinder und Höhe. Gebirgsmedizin. Ein Ratgeber für Laien* SAC Verlag, Berne, Switzerland (in review).

Conference papers

Wick C, Soltermann B, Brunner-La Rocca H, Hofmann A, Kriemler S. Pulmonary artery pressure adaption to high altitude of children and adults in comparison to adults with and without a history of high-altitude pulmonary edema. Poster presentation at the 15th Biennial Meeting of the North American Society of Pediatric Exercise Medicine, Colorado Springs, Sept 2008

Soltermann B, Wick C, Brunner-La Rocca H, Hofmann A, Kriemler S. Prevalence of acute mountain sickness in children upon fast ascent to high altitude. Poster presentation at 15th Biennial Meeting of the North American Society of Pediatric Exercise Medicine, Colorado Springs, Sept 2008

Wick C, Soltermann B, Brunner-La Rocca H, Hofmann A, Kriemler S. Pulmonary artery pressure adaption to high altitude of children and adults in comparison to adults with and without a history of high-altitude pulmonary edema. Schweiz. Zt Sportmed Sporttraum 2008; 56: 122

Soltermann B, Wick C, Brunner-La Rocca H, Hofmann A, Kriemler S. Prevalence of acute mountain sickness in children upon fast ascent to high altitude. Schweiz Zt Sportmed Sporttraum 2008; 56: 122

Theses

Wick C., Pulmonary artery pressure adaption to high altitude of children and adults in comparison to adults with and without a history of high-altitude pulmonary edema. Master Thesis, Institute of Exercise and Health Sciences, University of Basel, 2008.

Soltermann B., Prevalence of acute mountain sickness in children upon fast ascent to high altitude. Master Thesis, Institute of Exericse and Health Sciences, University of Basel, 2008.

Magazine and Newspapers articles

Höhenkrankheit bei Kindern. Bericht Neue Zürcher Zeitung, Februar 9, 2006.
http://www.nzz.ch/2006/02/09/sg/articledj9xt_1.9894.html

Radio and television

Forschung zwischen Himmel und Erde, Menschen-Technik-Wissenschaft, SF1, Moderation David Jens, Januar 12, 2008

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