Indoor air and health in school buildings

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Symptoms associated with exposure to indoor environment

- General symptoms
- Irritation symptoms
- Skin symptoms

Frequent symptoms are “feeling fatigue”, “heavy-headed”, “eye irritation” and “dry facial skin”

- Gender and allergy are associated with the symptoms outcome

- Scientific designs used to explore health in indoor environment have been cross-sectional, experimental (on humans) and laboratory (on cells).

Indoor air and health in schools

- General and irritation symptoms.
- Asthma, 26 % of 16 years old pupils in Oslo, this may be allergic or non-allergic type. Allergies. Respiratory infections or inflammations.
- Common symptoms among students at schools with poor indoor air quality were wheezing, cough with wheezing, and fever over 37◦C (Turunen et al, 2014).

- Common indoor air complaints in schools are varying temperature, poor indoor air quality, noise

Indoor air pollutions and health

Bacteria and fungal pollutions in schools and kindergartens

- Hussin et al. (2011) found that schools with unhygienic conditions are more prone to have high concentrations of both fungi and bacteria due to dusty floors and moldy surfaces. The study also found that occupants influenced on the indoor bacterial concentration but not on the fungal concentration.
- In another study, all room surfaces sampled in a child-care facility were contaminated with bacteria (Lee et al, 2007).

- Anti-bacterial effects by **α-pinene** may reduce number of infections from upper respiratory airways (Hong et al, 2004).

Particle pollution

- Exposure to particles in indoor air may cause irritation effects in the eye, nose and throat (Wargocki et al, 1999; Skulberg et al, 2004).
- Concentration of particles in the indoor air may be reduced by increasing the RH, while having good cleaning routines at school.

- Wood in indoor building materials may reduce variation of RH in indoor air

α-pinene and health

Health risk:

VOC from wood or its oxidized products may give mucosal irritation symptoms. However, experimental studies have revealed no irritation effects (Gminski et al, 2011, Nore et al, 2017)

Health promotion:

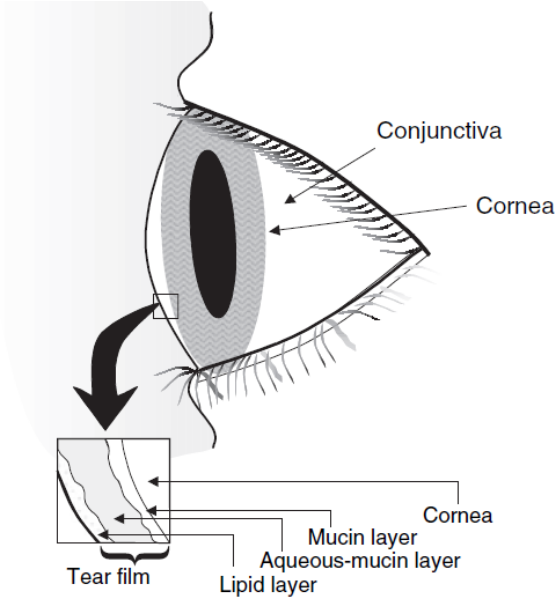
VOC from wood have an anti-inflammatory effect (Kim et al, 2015). This effect can reduce the number or severity of non-infectious respiratory inflammation, non-allergic asthma and eczema. These disorders are common among school students.

The importance of controlling the indoor environment and health

Temperature

- In an intervention study in tropical climate 11-year-old children performed the language and logical-thinking tasks significantly better in terms of speed at the lower temperature, while the less able pupils performed better on all tasks at the lower temperature. (Porras-Salazar et al, 2018).
- Call-centre operator performance, as indicated by average talk-time, improved by 4.9% when the air temperature was decreased by 2°C (Tham et al, 2004)
- Fang et al. (2002) found no significant effect of temperature and humidity on performance in 4.5-hour exposures ranging from 20°C/40%RH to 26°C/60%RH. General symptoms increased.

Temperature and relative humidity associated with eye symptoms (Wolkoff, 2003; Nøjgaard et al, 2005)



- Low RH (< ca. 20%) and high temperature may damage the tear film that protects the eye
- VOC may be oxidized by ozone to secondary organic aerosols
- Sensory irritation and inflammation in the outer part of the eye

Performance among schoolchildren and indoor air quality

- Significant associations were observed between percentages of students scoring satisfactory in mathematics and reading tests and both indoor temperature and ventilation rate (Haverinen-Shaughnessy et al, 2014)
- There is evidence of associations of reduced respiratory health effects and reduced student absence with increased ventilation rates. (Review by Fisk, 2017)

Traditionally, ventilation and heating / cooling systems have been used to control indoor climate.

Using wood to control the indoor climate may reduce health symptoms among users. In addition, a reduced use of energy will be beneficial to the environment

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