

Appendix 2. Brief summary of scientific findings on relationships between IEQ and health (organized by type of health effect) (from Mendell and Heath (2003))

This appendix includes studies on relationships between health and a broad range of IEQ factors, from HVAC or building characteristics to measured pollutants or thermal conditions. The section cites articles, grouped by type of health effect, reporting primary research on IEQ and health.

Respiratory Health Effects

Many recent studies have found objectively measurable upper or lower respiratory effects, some serious, associated with indoor pollutants or risk factors. In contrast, only a few years earlier, subjective symptoms were essentially the only health outcomes measured in IEQ studies (Mendell 1993). Among the indoor exposures or risk factors now most frequently and consistently associated with respiratory health effects are: the presence of moisture, water damage, and microbiological pollutants (Committee on the Assessment of Asthma and Indoor Air 2000; Bornehag et al. 2001), combustion products (Burr 2000), and animal and other biological allergens (Platts-Mills 2000). Other risk factors for respiratory health effects demonstrated in relatively few studies but important because of potentially widespread exposures and serious outcomes include: formaldehyde (Pazdrak et al. 1993; Wantke et al. 1996; Smedje et al. 1997; Garrett et al. 1999; Franklin et al. 2000; Norback et al. 2000a), plastics or plasticizers (Oie 1997; Jaakkola et al. 1999; Jaakkola et al. 2000b), nitrogen dioxide (Pilotto et al. 1997; Norback et al. 2000a); low or even recommended rates of ventilation (Menzies et al. 2000; Milton et al. 2000); chemicals in cleaning compounds (McCoach et al. 1999; Zock et al. 2001), outdoor pollutants or vehicle exhaust (Guo et al. 1999; Wyler et al. 2000; Steerenberg et al. 2001), and moisture or dirt in HVAC systems (Sieber et al. 1996; Mendell et al. 2003).

Risk factors found in buildings for respiratory infections include nitrogen dioxide (Pilotto et al. 1997), low ventilation rate (Fisk 2000; Menzies et al. 2000; Milton et al. 2000), humidification (Milton et al. 2000), and also lack of humidification (Green 1985).

Regarding specific health outcomes, identified risk factors for either asthma, increased pulmonary function variability, pulmonary hyperresponsiveness, or decreased pulmonary function include fungi and bacteria (Hoffman et al. 1993; Smedje et al. 1997; Garrett et al. 1998a; Garrett et al. 1998b; Seuri et al. 2000a), endotoxin (Michel et al. 1996; Michel et al. 2001), dust mites (Platts-Mills 2000), animal dander (Smedje et al. 1997; Platts-Mills 2000), formaldehyde (Smedje et al. 1997), chemicals in cleaning compounds (McCoach et al. 1999; Zock et al. 2001), outdoor pollutants (Guo et al. 1999; Steerenberg et al. 2001), dampness or water damage (Taskinen et al. 2000), carpets (Hansen 1987), and open shelves (Smedje et al. 1997).

Indoor environmental risk factors for lung inflammation include endotoxins (Michel et al. 2001), formaldehyde (Franklin et al. 2000), and outdoor pollutants (Steerenberg et al. 2001). Risk factors for bronchial obstruction include PVC flooring (Jaakkola et al. 1999), textile wall materials (Jaakkola et al. 1999), and plasticizer-emitting materials (Oie 1997). Risk factors for asthmatic symptoms include moisture or dirt in HVAC systems (Mendell

et al.), plastic wall materials (Jaakkola et al. 2000b), and outdoor pollutants (Ramadour et al. 2000). Risk factors for atopy include fungi (Garrett et al. 1998a), formaldehyde (Garrett et al. 1999), dampness or mold (Taskinen et al. 2000), and vehicle exhaust (Wyler et al. 2000). Indoor risk factors for allergic alveolitis include dampness, water damage, or mold, in buildings or HVAC systems (Hodgson et al. 1987; Woodard et al. 1988; Kreiss 1989; Thörn et al. 1996; Seuri et al. 2000a).

Neurologic Symptoms

Risk factors for neurologic symptoms, such as headache, confusion, difficulty thinking, difficulty concentrating, or fatigue, include dust (Mølhave et al. 2000), VOCs (Mølhave et al. 1985; Otto et al. 1992), a used carpet taken from a complaint building (Wargocki et al. 1999; Lagercrantz et al. 2000), small particles (Mendell et al. 2002a), and higher temperatures within the comfort envelope (Mendell et al. 2002a).

Other Health Effects

A variety of IEQ risk factors have been identified for other health outcomes: nasal swelling, congestion, or inflammation (Pazdrak et al. 1993; Walinder et al. 1998; Walinder et al. 1999; Norback et al. 2000a; Norback et al. 2000b; Steerenberg et al. 2001; Walinder et al. 2001b); irritant symptoms of nose, throat, eye, or skin (Ten Brinke et al. 1998; Walinder et al. 1998; Rudblad et al. 1999; Mølhave et al. 2000; Nagda and Hodgson 2001); and nonspecific symptoms (Jaakkola and Heinonen 1989; Norback and Torgen 1989; Mendell and Smith 1990; Norback et al. 1990; Skov et al. 1990; Hodgson et al. 1991; Jaakkola et al. 1991a; Reinikainen et al. 1992; Ryländer et al. 1992; Wyon 1992; Mendell 1993; Menzies et al. 1993; Gyntelberg et al. 1994; Sieber et al. 1996; Wantke et al. 1996; Li et al. 1997; Garrett et al. 1998a; Kemp et al. 1998; Meyer et al. 1999; Seppänen et al. 1999; Meklin 2000; Taskinen et al. 2000; Seppänen and Fisk).