

## **GERIATRIC STUDY IN PORTUGAL ON HEALTH EFFECTS OF AIR QUALITY IN ELDERLY CARE CENTERS**

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### *Background and Objectives*

The age of the European population is rising and the percentage of adults aged 65 years and older is projected to increase from 16% in 2000 to 20% in 2020 [1]. It has been estimated that older persons spend about 19-20 hours per day indoor [2]. Moreover, elderly care homes have the potential to influence people's lives socially, physically and psychologically [3]. As a result, the study of indoor air quality (IAQ) and thermal environments in the elderly population is becoming an important issue to be addressed by clinical research. In fact, older persons may be particularly at risk of detrimental effects from pollutants, even at low concentrations due to their common reduced immunological defense and multiple underlying chronic diseases. Several health-related effects may be caused (or worsened if already present) by exposure to poor IAQ, including eye irritation, nausea, upper respiratory complications, cognitive impairment, asthma, respiratory infections, cardiovascular disease, chronic obstructive pulmonary disease, and cancer. In this sense it was design the GERIA Project - Geriatric study in Portugal on Health Effects of Air Quality in Elderly Care Centers which will examine 20 ECCs chosen among 60 in Porto and Lisbon, each of which will be studied to collect the following data types: (i) building physical and environmental characteristics; (ii) air change rate using tracer gas technique; (iii) health and quality of life questionnaires: BOLD questionnaire, World Health Organization Quality of Life – BREF, Mini Mental State (MMS) and Geriatric Depression Scale (GDS) as well as a socio-demographic questionnaire; (iv) exhaled breath condensate, spirometry and swab samples. This prospective cohort study will provide crucial information about ECCs construction characteristics, indoor environment and prevalence of cardio-respiratory diseases in older persons in Portugal. To our knowledge, this is the first study in Portugal to assess effects of indoor air contaminants on health status and quality of life in older persons living in ECCs. This paper explore the first results of this ongoing study, analyzing the impact of environmental health variables and ventilation assessment in 22 elderly care centers (ECCs) in Porto urban area, Portugal.

### *Methods*

The ECC sample size ( $n = 22$ ) was accomplished by randomization by type of ECC in Porto urban area. Indoor environmental parameters were measured twice, during winter and summer in 141 ECCs rooms within dining rooms, drawing rooms, medical offices and bedrooms including the bedridden subgroup. These areas were assessed for IAQ chemical ( $\text{CO}_2$ , CO, formaldehyde, TVOC,  $\text{PM}_{10}$ ,  $\text{PM}_{2.5}$ ) and biological contaminants (bacteria and fungi). Thermal Comfort (TC) parameters were measured following ISO 7730:2005, included relative humidity, temperature and air velocity in order to determine PMV and PPD indexes. It was also performed a building and ventilation characterization survey and a standardized respiratory health questionnaire (BOLD) and quality of life questionnaire (WHOQOL-BREF) to 143 residents. Outdoor samples were also collected for comparison to the indoor measurements.

### *Findings*

The results from elderly sample and ECCs characterization are presented in Table 1 and Table 2. Our environmental preliminary results point out that: (i) Overall IAQ parameters are within the

national and international reference levels; (ii) Prevalence of indoor sources contaminants ( $P=0.01$ ); (iii) Fungi samples raise concern showing incidence of *Aspergillus fumigatus* that can cause invasive lung infections in susceptible individuals as elderly; (iv) due to poor insulation, the winter season PMV index show results in the ‘slightly cool’ thermal sensation scale which may potentiate respiratory tract infections; (v) PPD ( $P=0.032$ ) and PMV ( $P=0.001$ ) indexes show significant differences by season. Ongoing analysis is focusing on the interaction between IAQ and TC variables within building, ventilation characteristics and respiratory health questionnaires.

Table 1. Elderly sample characterization

ECCs Sample	39% (n = 22) Total in Porto = 57
Elderly living in ECCs Sample	54% (n = 716) Total in Porto = 1323
HQoL Questionnaires Sample	20% (n = 143) out of 716
Dementia <sup>a</sup> [Questionnaires Sample]	68% (n = 143)
Age <sup>b</sup> (years)	84 [68 – 103]
Gender	Ladies = 85%    Gentlemen = 15%

<sup>a</sup> Mini Mental State Examination; <sup>b</sup> mean [min-max]

Table 2. ECC building characteristics

Building age <sup>b</sup> (Years)	62 [8 – 191]
Close proximity to roads with heavy traffic (%)	89
Occupants per building (Range in No.)	7 - 138
Adapted to ECC (%)	64
Insulation (Walls & Ceiling) (%)   Single pane glass (%)	32   85
Stone masonry (%)	40
Central heating systems (%)	50
Natural ventilation Only (%)   Mixed Ventilation (%)	14   86
Windows frames (%)	Wood: 40   aluminium: 35   pvc: 25

<sup>b</sup> mean [min-max]

**Conclusions and Practical Implications:** Our study suggests that simple measures, such as insulating ceilings, walls and windows, could provide health benefits to ECCs residents and to the building energy efficiency.

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