Cognitive impact of chronic low-level carbon monoxide exposure in older adults

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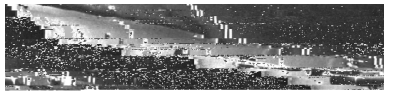
Low-level CO Exposure

Evidence on the effects associated with low-level exposure is limited and inconsistent

Acute low-level CO exposure (duration ≤24 hours)



Experimental studies:

- COHb levels of around 5% associated with impaired cognitive function

Chronic low-level CO exposure (duration >24 hours)

Case reports:

- Headache and nausea
- Affective disorders
- Memory impairments and motor slowing (Myers et al., 1998).

McFarland et al., 1972

Epidemiological studies:

- Associations between air pollution and increased risk of stroke, MI and heart failure
- CO exposure and increased dementia development risk (Chang et al., 2014).

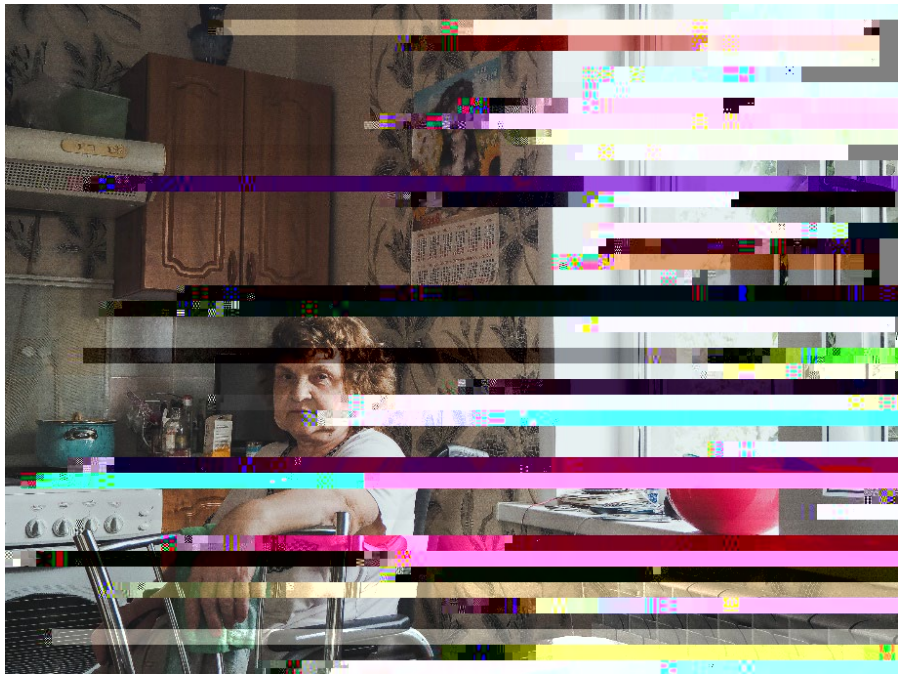
Neuropsychological deficits may present following less severe exposures

- May be persistent in nature.

High Risk groups

Poisoning severity depends on human and environmental factors:

- Duration of exposure
- Concentration of CO in the air
- Pre-existing disease



Older adults may be:

- More susceptible to the effects of CO

  Reduced physiological reserve

- Frequently associated with gas appliances

- Particular concern in the UK as gas appliances are widely used for heating and cooking

A percentage of the population may be at risk from low-level CO exposure

- At levels above those considered safe
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Aims and Method

Fire officers report high levels of confusion in older residents

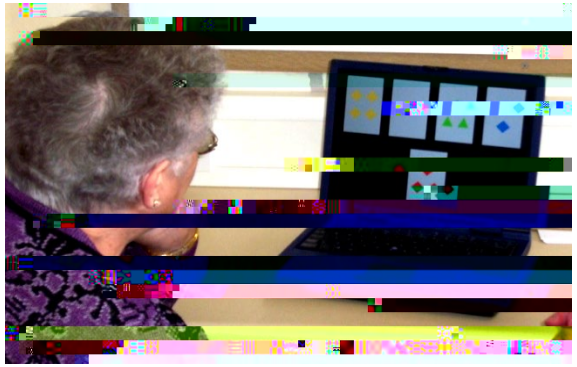
- Low-level exposures may be an unidentified cause of cognitive impairment

Aims:

- Examine the proportion of older adult homes in Coventry with low-level CO
- Examine the effects of chronic low-level CO exposure on cognitive function

A sample of 106 older adults (*M*=75.60 yrs) residing in Coventry were recruited

- Home CO monitoring 1 month
- Neuropsychological assessment
- Follow-up CO monitoring and assessments at 7 months
- Examine longer term impact



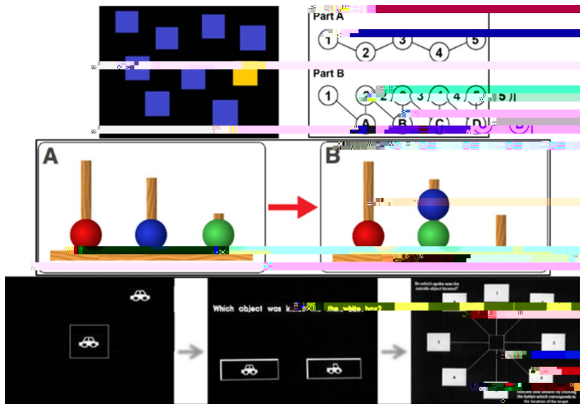


Figure 1. CO levels over 1-month showing continuous extremely low CO levels. Gas fire and boiler

Figure 2. CO levels over 1-month showing higher short

Discussion: Cross-sectional

Endogenous CO production:

- Results from the degradation of haem catalysed by haem oxygenase
- Biliverdin, free iron and CO

(Queiroga, Vercelli, & Vieira, 2015)

- Involved in various cellular functions including vasodilation and proliferation
- Plays a crucial role in cellular maintenance, protection, regeneration and survival

These physiological processes may also result from low-levels of inhaled CO:

- Potentially **minimise risk** to the **central nervous system**
- Playing a **protective** or even **beneficial role** up to a certain dose and duration

Discussion: Cross-sectional

For example:

- Endogenous CO

Discussion: Cross-sectional

Cardiovascular risk factors:

Heart failure, coronary artery disease and atrial fibrillation are more common in older adults

- Lead to greater decreases in CBF and chronic hypo-perfusion
- **Further compromising** the already **reduced CBF** that is present in ageing

The effects of these age and disease-related vascular changes on CBF have been associated with:

- **Increased risk of cognitive decline, MCI** and **dementia development**

The potential protective effects of low-level exogenous CO may be of particular benefit to older adults

However any protective effects are likely to be:

- Transient with COHb accumulation over time placing stress on the body's physiological resources
- Reaches a point where the body can no longer compensate for the continuous uptake of CO
- Insufficient CBF and ischaemia may follow
- Resulting in a shift from positive to negative cognitive impacts.

Longitudinal Results: Longer-term Effects

Examined the longer-term impact of exposure on cognitive function

- Determine whether the observed beneficial effects are short lasting and result in damage given sufficient exposure time/ time post-exposure
- 78 participants completed the follow-up at 7 months

Similar proportion of homes with some CO readings: 47/78 (60%)

Longer-term impact from T1 exposure on performance at 7 months

Cognitive performance **decreased** with greater CO exposure

- Processing speed
- Intra-individual variability in responding
- Selective attention, resistance to distractor interference

Overall Results

Relatively consistent pattern of results:

- **Positive CO-related effects** observed across a range of functions in the **short-term** following exposure

However, the majority of these effects were short-lasting and **lead to longer-term negative impacts** either:

- Given sufficient time post-exposure (negative impacts from T1 exposure present at 7 months)
- Accumulation of two one-month exposure periods (total exposure)

This shift of effects was observed across a range of functions:

- Selective attention and resistance to distractor interference
- Memory recognition
- Auditory working memory
- Processing speed

Overall Results

Particular cognitive areas appear to be **more resilient to CO** exposure associated with **positive effects only**:

- Visual working memory
- Currently unclear whether these positive effects are followed by negative impacts
- Likely that negative impacts do follow at levels above those reported

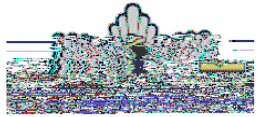
The results indicate that the effects of chronic low-level CO exposure may be **viewed on a continuum:**

Overall Discussion

Thank you for listening

Acknowledgements

Project funded by the CO Research Trust



Watch Commanders
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