

# Clothing insulation as a behavioural adaptation for thermal comfort in Indian office buildings

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# Introduction

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  - Clothing insulation
- Results
  - Clothing patterns
  - Adjustments
    - Indoor temperature
    - Outdoor temperature
- Discussion

# Research questions

- What clothing practices are followed in Indian offices?
- How does clothing behaviour vary with season and the type of office building?
  - and indoor and outdoor environmental conditions?
- What are the differences in the clothing behaviour of male and female office workers?

# Context

- Need to reduce energy use whilst maintaining the comfort, productivity and well-being of occupants
- Clothing adjustment is an important adaptive measure
- Field studies elsewhere show that clothing insulation is influenced by indoor and outdoor temperature
- Studies show differences in clothing behaviour between men and women

# Context

- India has a wide range of clothing attire
  - Geographical, climatic, cultural, economic diversity
  - Wide range of clothing material and degree of customization
- Assimilation of international clothing styles – formal 'dress codes'

# Methods

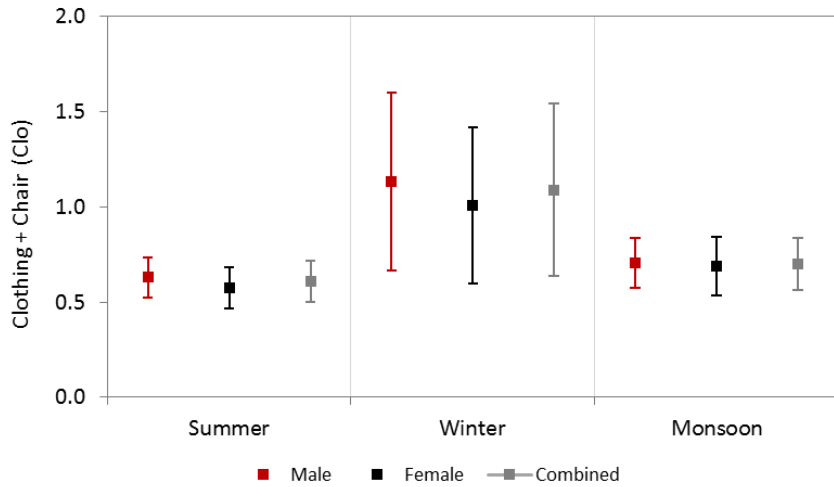
- India Model for Adaptive Comfort (IMAC) field studies, 2011-14
- 5 climate zones = 5 cities
- 3 office building types – NV, MM, AC
- 3 seasons – summer, monsoon, winter
- 16 buildings
- 6330 survey responses – ‘right here, right now’

# Methods *(contd)*

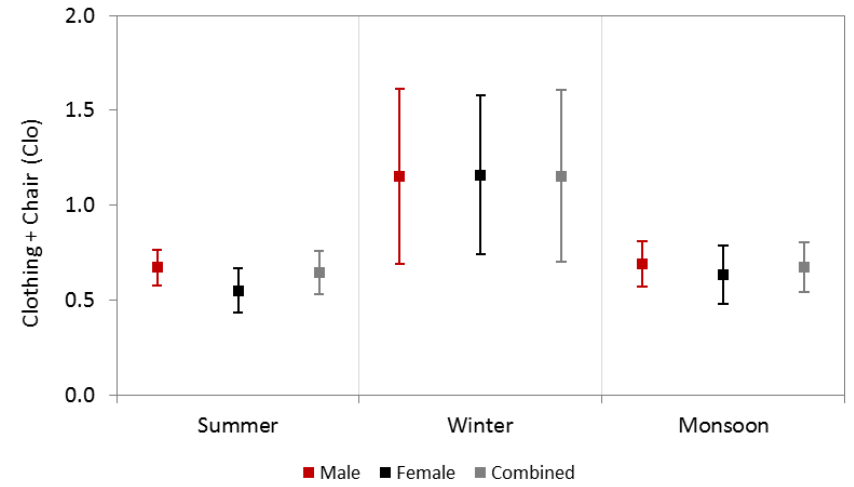
- Extensive clothing garment checklist (+Indian ensembles)
- Light, medium, heavy weight
- Insulation values - ASHRAE Standard 55-2010
  - Interpolation of insulation values for missing weights or garments
- +0.15 clo for cushioned chair

# Results

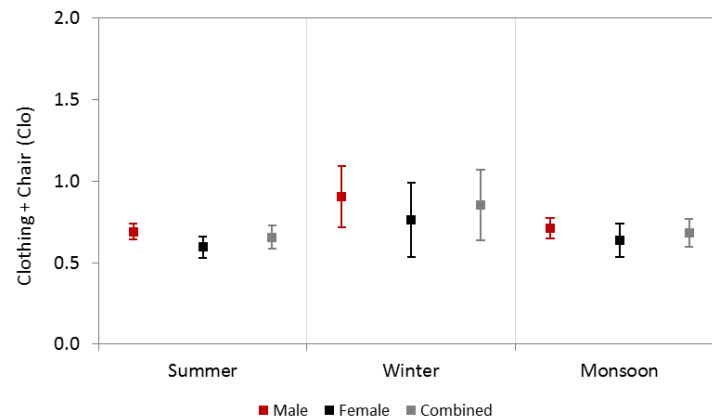
### NV Buildings



### MM Buildings



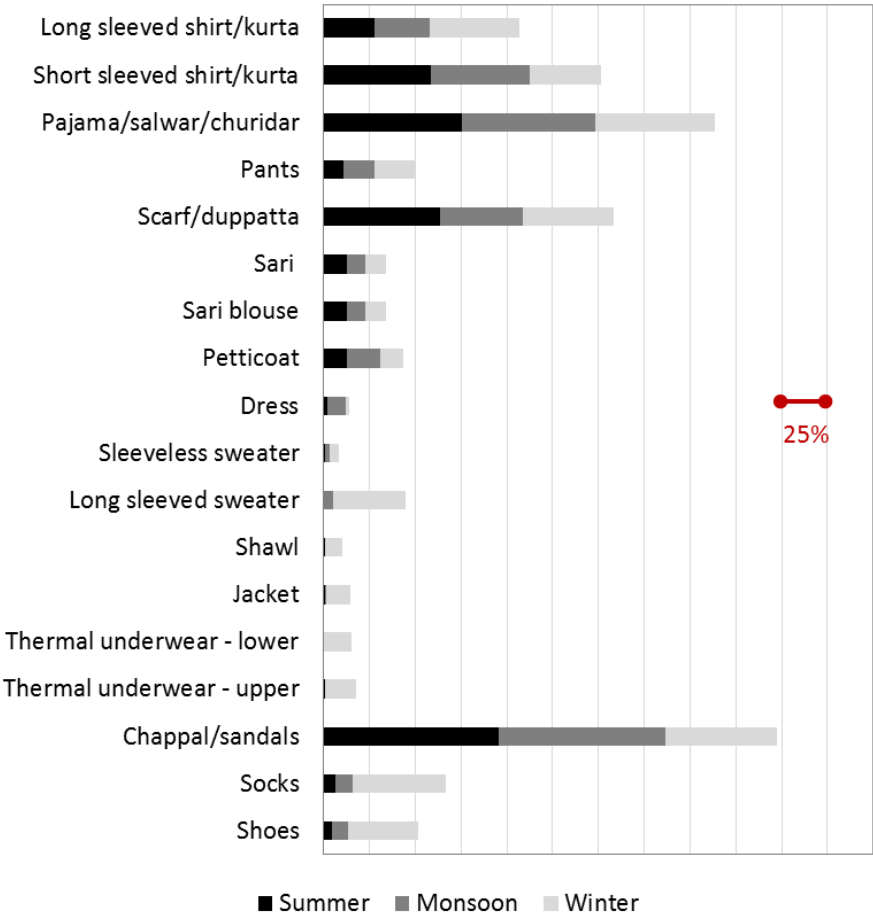
### AC Buildings



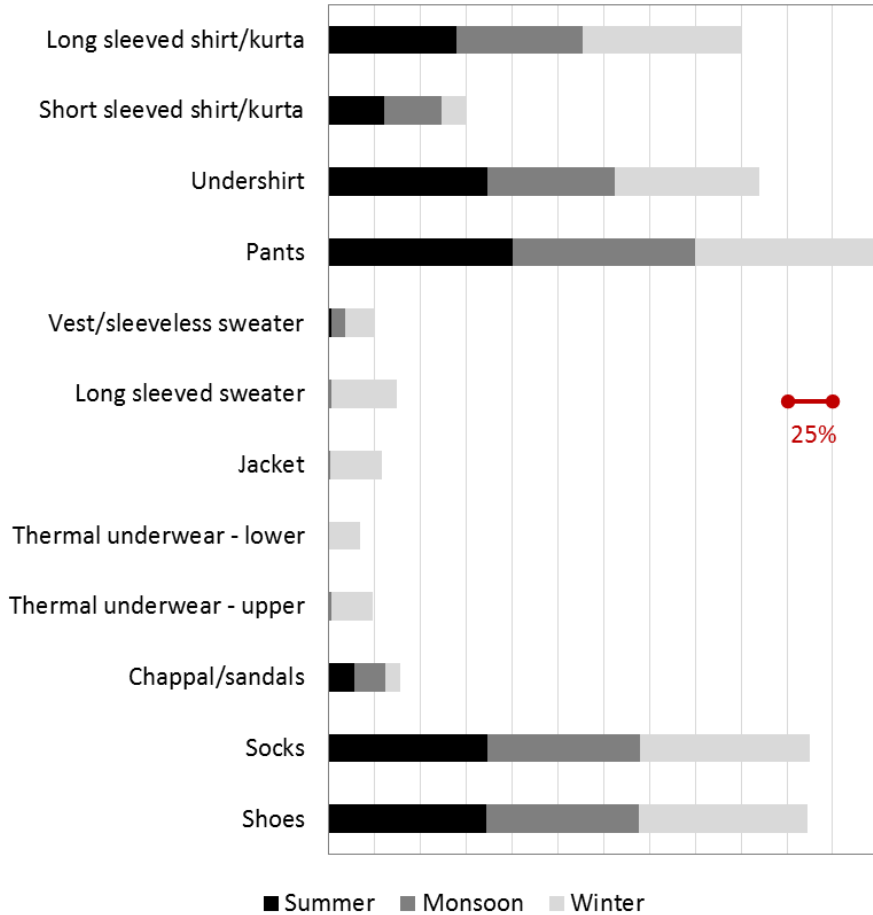


# Results

% Distribution of Female clothing

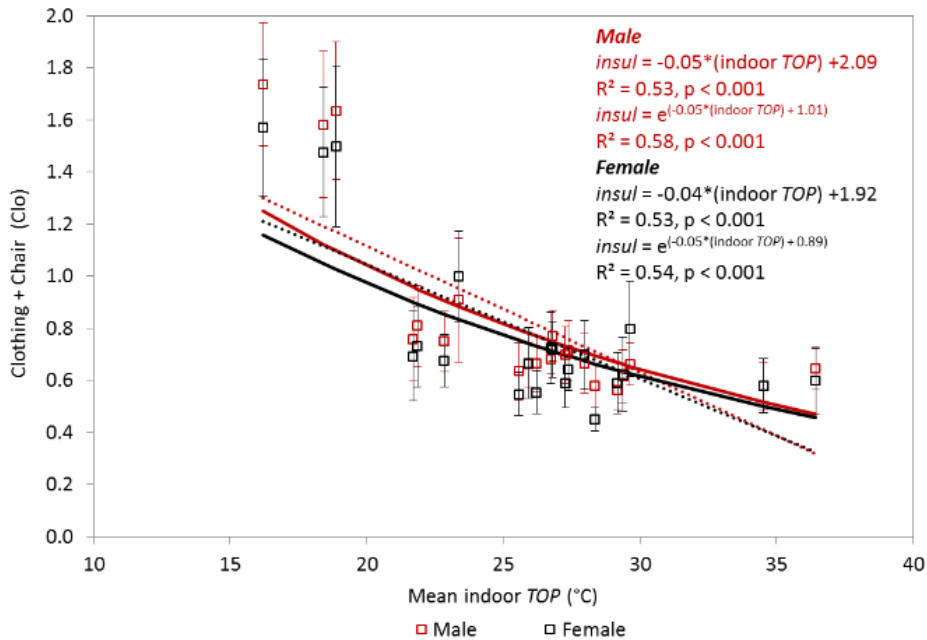


% Distribution of Male clothing

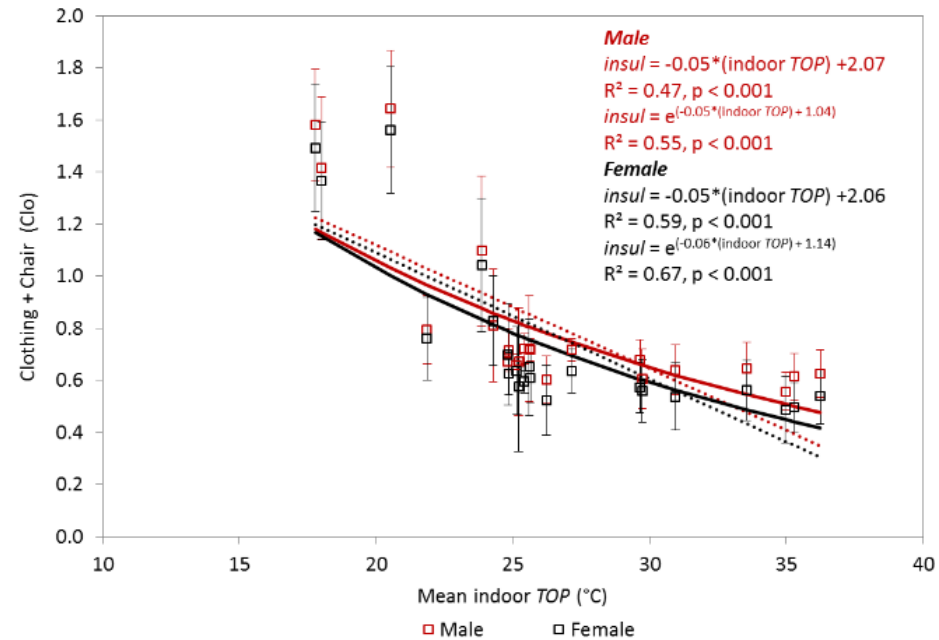


# Results

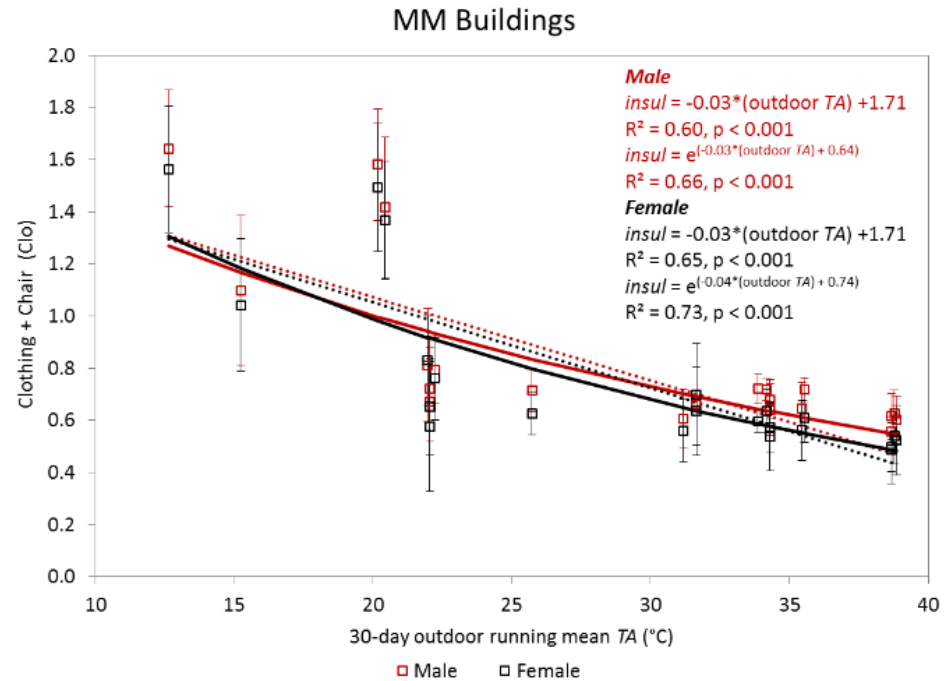
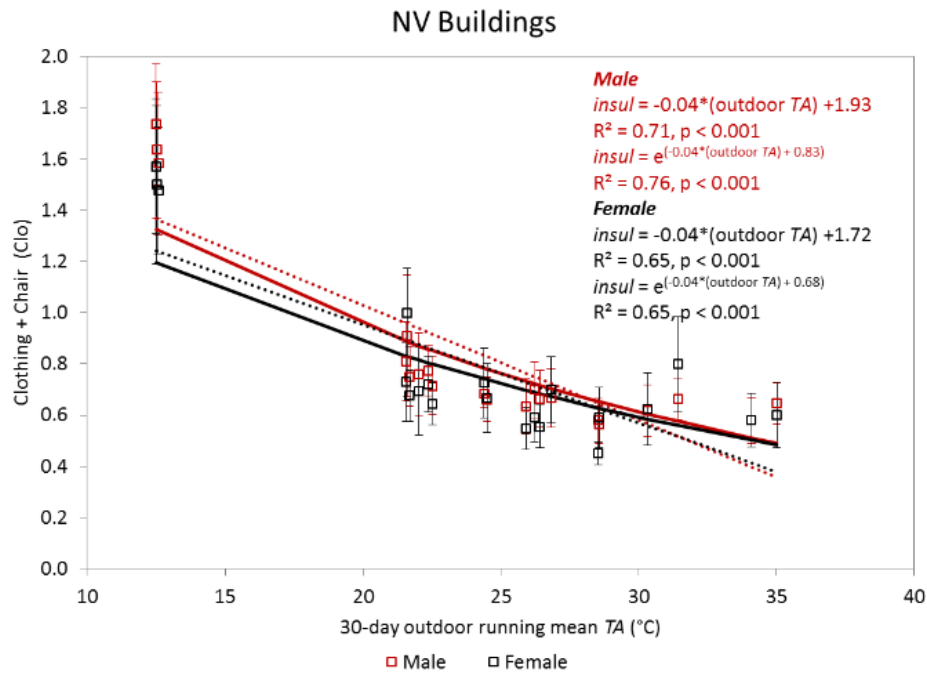
NV Buildings



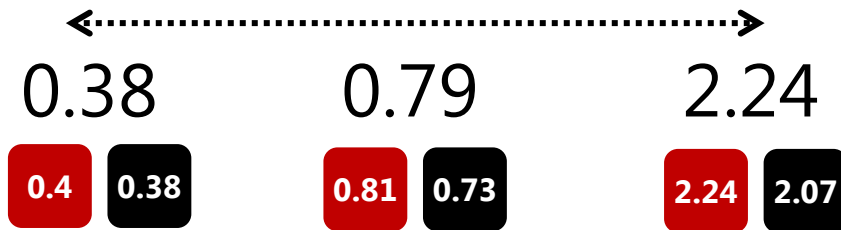
MM Buildings



# Results



# Discussion



- Female office workers wore lower clo on an average
- Variability in clo was higher in NV and MM buildings
- Decrease in clo with increase in indoor temperature was similar for male and female office workers
- Strong relationship between clo and outdoor temperature in NV buildings
- Changing clothing as an adaptive mechanism is more pronounced in NV buildings
- Adaptive clothing behaviour is least evident in AC buildings
- Important to offer the ability for adaptation through clothing to suit personal preferences, climatic and cultural context

# Thank You.

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