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www.elsevier.com/locate/jtherbio

PII: S0306-4565(16)30435-1
DOI: http://dx.doi.org/10.1016/j.jtherbio.2017.07.002
Reference: TB1954

To appear in: *Journal of Thermal Biology*

Received date: 4 January 2017
Revised date: 6 July 2017
Accepted date: 10 July 2017

Cite this article as: Yu Jiao, Hang Yu, Tian Wang, Yusong An and Yifan Yu, The Relationship between Thermal Environments and Clothing Insulation fo Elderly Individuals in Shanghai, China, *Journal of Thermal Biology* http://dx.doi.org/10.1016/j.jtherbio.2017.07.002

# The Relationship between Thermal Environments and Clothing Insulation for Elderly Individuals in Shanghai, China

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## Abstract

The relationship between thermal environmental parameters and clothing insulation is an important element in improving thermal comfort for the elderly. A field study was conducted on the indoor, transition space, and outdoor thermal environments of 17 elderly facilities in Shanghai, China. A random questionnaire survey was used to gather data from 672 valid samples. A statistical analysis of the data was conducted, and multiple linear regression models were established to quantify the relationships between clothing insulation, respondent age, indoor air temperature, and indoor relative humidity. Results indicated that the average thermal insulation of winter and summer clothing is 1.38 clo and 0.44 clo, respectively, for elderly men and 1.39 clo and 0.45 clo, respectively, for elderly women. It was also found that the thermal insulation of winter clothing is linearly correlated with age, and that there were seasonal differences in the relationship between clothing insulation and the environment. During winter, the clothing insulation is negatively correlated only with indoor temperature parameters (air temperature and operative temperature) for elderly males, while it is negatively correlated with indoor temperature parameters as well as transition space and outdoor air temperature for elderly females. In summer, clothing insulation for both elderly males and females is negatively correlated with outdoor temperature, as well as indoor temperature parameters (air temperature and operative temperature). The thermal insulation of summer clothing is also negatively correlated with transitional space temperature for males.

**Keywords:** Thermal Environment; Clothing Insulation; Elderly People; Shanghai



## 1. Introduction

Clothes, which act as a barrier between the human body and external elements, have an important influence on the exchange of heat and humidity between the human body and the environment, which influences human heat balance (Havenith, 2003; Voelker et al., 2009; Talukdar et al., 2016). Clothing allows the wearer to consciously