

ARE WOMEN FEELING COLDER THAN MEN IN AIR-CONDITIONING BUILDINGS?

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1 INTRODUCTION

Recently the international media like in USA, Canada, UK, Denmark, Germany etc. has been discussing the issue of differences between men and women regarding thermal comfort and the preferred room temperature. This presentation will discuss the issue of thermal comfort and the existing knowledge on the influence of gender, age, race, etc.

2 RESULTS

2.1 The Dutch study

In their paper, researchers Boris Kingma and Wouter van Marken Lichtenbelt state, "Indoor climate regulations are based on an empirical thermal comfort model that was developed in the 1960s. Standard values for one of its primary variables—metabolic rate—are based on an average male, and may overestimate female metabolic rate by up to 35 percent". According to their experiment with 16 females performing sedentary work, they measured a significant lower metabolic rate for women than the metabolic rate for a "standard man", which they found in literature. This will according to the authors result in a higher preferred room temperature for women.

2.2 The existing literature

Fanger (1982), Fanger and Langkilde (1975), and Nevins et al. (1966) used equal numbers of male and female subjects, so comfort conditions for the two sexes can be compared. The experiments show that men and women prefer almost the same thermal environments. Women's skin temperature and evaporative loss are slightly lower than those for men, and this balances the somewhat lower metabolism of women. The reason that women often prefer higher ambient temperatures than men may be partly explained by the lighter clothing normally worn by women.

First, the primary reason is that we are overcooling buildings in summer, using enormous amounts of energy, and creating uncomfortably cold conditions for everyone. A study at Lawrence Berkeley National Laboratory found that average temperatures in office buildings in the U.S. are colder in the summer than in the winter (exactly the opposite of what they should be), and are actually lower than the minimums recommended by the standards

2.3 The existing standards

Existing international standards like ISO EN7730, EN15251 and ASHRAE 55 are based on the same basic studies described above. These standards do not specify different room temperatures for women and men when doing the same work and dressed in similar clothing. As explained by Gail Brager, UC-Berkeley:

Contrary to what has been suggested, these standards are not devised exclusively for men. They are based on extensive laboratory studies of both men and women wearing the same clothing, engaged in the same activity, and exposed to a wide variety of thermal conditions (air temperature, surface temperature, humidity and air movement). Metabolic heat production was simply a proxy for the kind of activity. And while it is one of many variables used in an empirical formula, it is not an input to a heat balance equation, as one might find in a thermo-physiological model (which exists, but was not the basis for the standards) The primary reason is that we are overcooling buildings in summer, using enormous amounts of energy, and creating uncomfortably cold conditions for everyone. A study at Lawrence Berkeley National Laboratory found that average temperatures in office buildings in the U.S. are colder in the summer than in the winter (exactly the opposite of what they should be), and are actually lower than the minimums recommended by the standards.

In the main studies, where they did the same sedentary work and wore the same type of clothing, there were no differences between the preferred temperature for men and women. So the researchers' finding of a lower metabolic rate for females will not influence the recommended temperatures in the existing standards. Also their study is not conclusive. They only studied 16 females at a sedentary activity. They should also have studied 16 men at the same activity to be able to compare. The reason why we, in some field studies, find that women prefer higher room temperature than men is attributed to the level of clothing. Women adapt better their clothing to summer conditions while men are still wearing suit and tie. So if the thermostat is set to satisfy the men, the women will complain about being too cold. In the standard, this adaptation of clothing to summer is taken into account so if the standard is followed the women would be satisfied; but maybe not the men

3 CONCLUSIONS

The extensive studies, which form the basis for existing international standards for the thermal environment (ANSI/ASHRAE Standard 55, ISO EN 7730) included equal amount of male and female subjects and no difference in preference was observed. Despite this fact, we may often find women are colder during summer time in air conditioned offices. This can however, in most cases be attributed to the difference in clothing level between men and women. It seems the thermostat settings in summer in air-conditioned buildings are often too low and below the recommended range in existing standards.

4 REFERENCES

- ASHRAE 2013. *Thermal Environmental Conditions for Human Occupancy* ASHRAE standard 55-2013
- Fanger, P.O., and G. Langkilde. 1975. *Interindividual differences in ambient temperature preferred by seated persons*. ASHRAE Transactions 81(2): 140-147.
- Fanger, P.O. 1982. *Thermal Comfort*. Robert E. Krieger, Malabar, FL
- Kingma, B. and van Marken Lichtenbelt, Wouter. 2015. *Energy consumption in buildings and female thermal demand*. Nature climate change, Letters, August 3, 2015
- Nevins, R.G., F.H. Rohles, Jr., W.E. Springer, and A.M. Feyerherm. 1966. *Temperature-humidity chart for thermal comfort of seated persons*. ASHRAE Transactions 72(1):28