Effect of clothing weight on body weight

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BACKGROUND: In clinical settings, it is common to measure weight of clothed patients and estimate a correction for the weight of clothing, but we can find no papers in the medical literature regarding the variability in clothing weight of adults with weather, season and gender.

METHODS: Fifty adults (35 women) were weighed four times during a 12-month period with and without clothing. Clothing weights were determined and regressed against minimum, maximum and average daily outdoor temperature.

RESULTS: The average clothing weight (± s.d.) throughout the year was significantly greater in men than in women (1.2 ± 0.3 vs 0.8 ± 0.3 kg, P < 0.0001). The average within-person minimum and the average within-person maximum clothing weights across the year were 0.9 ± 0.2 and 1.5 ± 0.4 kg for men, and 0.5 ± 0.2 and 1.1 ± 0.4 kg for women, respectively. The within-person s.d. in clothing weight was 0.3 kg for both men and women. Over the 55 °C range in the lowest to the highest outdoor temperatures, the regressions predicted a maximal change in clothing weight of only 0.4 kg in women and 0.6 kg in men.

CONCLUSION: The clothing weight of men is significantly greater than that of women, but there is little variability throughout the year. Therefore, a clothing adjustment of approximately 0.8 kg for women and 1.2 kg for men is appropriate regardless of outdoor temperature.

Keywords: clothing weight; body weight; clinical assessment; outdoor temperature; season

INTRODUCTION

With the rising rates of overweight and obesity, clinical measurement of body weight for calculation of body mass index is becoming increasingly important. Most clinical research studies reporting health effects associated with body mass index use body weights measured for subjects wearing minimal clothing. However, in many private clinical practices, body weights are measured in patients who are fully clothed but without shoes. We find no papers in the medical literature regarding the variability of clothing weight in adults (between people or across seasons). One study has reported on the accuracy of field workers to estimate the clothing weight of children. This study was done during a single season (summer), but attempts were made to simulate clothing weights for other seasons.

Using data from a clinical weight-loss study, we calculated clothing weight and compared that with the average, minimum and maximum temperature for each day to determine how much of an effect outdoor temperature has on clothing weight.

SUBJECTS AND METHODS

The inclusion criteria for subjects for this study included a body mass index between 27 and 35 kg m^-2 and age between 18 and 50 years. There were four data collection time points across a 12-month period. In all, 50 subjects were enrolled at the first two time points, 48 at the third time point and 47 at the fourth time point. Subjects were recruited from the Clinical Nutrition Center database and by advertisement in local news media. The Institutional Review Board of the University of Wisconsin-Madison approved the protocol, consent form and all advertisements.

The main objectives were to determine the average clothing weight and if clothing weight was affected by outdoor temperature. Subjects were part of a weight-loss study during which the majority of weight loss happened between baseline and 12 weeks. Data were collected at baseline, 12 weeks, 16 weeks and 52 weeks.

Clothed weight was measured on an electronic balance that was part of a foot-to-foot bioelectrical impedance analyzer (Tanita Model 310, Chicago, IL, USA). Subjects were instructed to remove outerwear, shoes and socks (no more specific instructions were provided). Near-nude (swimsuit or tight-fitting underclothes) weight was recorded by a BOD POD (COSMED USA, Inc, Concord, CA, USA) apparatus within 30 min of the clothed weight. Both devices were calibrated daily using the same calibration weights. Subjects fasted overnight prior to weight measurement. Clothing weight was calculated by subtracting the near-nude weight from the clothed weight. Daily temperatures were obtained from the Wisconsin State Climatology Office. Clothing weights were regressed against minimum, maximum and average daily temperatures for the region.

Intra-individual variance components were estimated using a one-way random effects model, with subject as the random effect. The effects of temperature on clothing weight were assessed using linear regression. All statistical analyses were run using SAS V9.2 (SAS Institute, Inc, Cary, NC, USA).

RESULTS AND DISCUSSION

At baseline, the average weight and age of the 35 women were 87.9 ± 9.3 kg and 42.8 ± 5.5 years and for the 15 men were 106.6 ± 11.8 kg and 41.3 ± 5.2 years. The average clothing weight (± s.d.) throughout the year was significantly greater in men than in women (1.2 ± 0.3 vs 0.8 ± 0.3 kg, P < 0.0001). The average within-person minimum and the average within-person maximum clothing weights across the year were 0.9 ± 0.2 and 1.5 ± 0.4 kg for men, and 0.5 ± 0.2 and 1.1 ± 0.4 kg for women. The within-person s.d. in clothing weight was 0.3 kg for both men and women. There was no correlation between clothing weight and near-nude weight of clothing, but we can find no papers in the medical literature regarding the variability in clothing weight of adults with weather, season and gender.
weight in men. There was a marginally significant correlation
(r = 0.17, P = 0.053) between clothing weight and near-nude
weight in women.

On study days during the year, minimum and maximum
outdoor temperatures were –22.8 °C (–9 °F) and 31.7 °C (89 °F).
The relationship between clothing weight and average daily
temperature is shown in the Figure 1. The regression equation
for women was: clothing weight, kg = 0.844 – 0.0075 (average
daily temperature, °C) (R² = 0.055, P = 0.006) and for men
was: clothing weight, kg = 1.229 – 0.0113 (average daily tempera-
ture, °C) (R² = 0.123, P = 0.006). The slopes of the regression
lines were not significantly different (P = 0.4) between women
and men. Correlations were similar when clothing weight
was predicted from minimum or maximum daily temperatures
(data not shown).

Average daily temperature explained only 6% of the variation
in clothing weight in women and 12% of the variation in men.
Over the 55 °C range in the lowest to the highest outdoor
temperatures, the regressions predicted a maximal change in
clothing weight of only 0.4 kg in women and 0.6 kg in men.

In summary, the clothing weight of men is greater than that of
women. The influence of daily temperature of clothing weight was
small, so it is not necessary to correct for outdoor temperature
when correcting body weights for clothing. Based on these data,
the recommended clothing adjustment is 0.8 kg for women and
1.2 kg for men.

CONFLICT OF INTEREST
The authors declare no conflict of interest.

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REFERENCE
1 Tuan T, Marsh DR, Ha TT, Schroeder DG, Thach TD, Dung VM et al. Weighing
vietnamese children: how accurate are child weights adjusted for estimates of