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EFFECTS OF INDOOR THERMAL ENVIRONMENT ON HUMAN FOOD INTAKE, PRODUCTIVITY, AND COMFORT: PILOT RANDOMIZED CROSSOVER TRIAL

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Abstract

Objective: We hypothesized that exposure to mild temperatures above the human thermoneutral zone would decrease caloric intake in a sedentary office environment.

Methods: Women ($n = 25$) were randomized in a crossover design to perform seated office work for 7 hours in a thermoneutral condition (control; 19–20°C) and a condition above the thermoneutral zone (warm; 26–27°C). Food intake was estimated by weight and bomb calorimetry, peripheral temperature by thermal imaging, and thermal comfort and productivity by questionnaires. Mixed effects models were used to examine the effects of thermal condition on caloric intake.

Results: Participants ate on average 357 kcal less in the warm condition, adjusting for body mass index and peripheral temperature ($p=0.0219$). According to the survey results at midday (after 3.5 hours of exposure), 96% of the participants in the warm condition reported being comfortable ($n=24$) compared with 32% in the control condition ($n=8$). More participants reported being as productive or more productive than usual in the warm condition ($n=22$, 88%) than in the control condition ($n=12$, 48%).

Conclusions: This line of research is worthy of further exploration. Untightening climate control towards warmer conditions during summer to increase comfort and productivity while decreasing caloric intake may prove both effective and comfortable.

REGISTRATION:

This study was registered with [ClinicalTrials.gov](https://clinicaltrials.gov) (NCT02507310).

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Keywords

indoor ambient temperature; caloric intake; thermal comfort

Introduction

A recent epidemiologic study suggest that ambient temperature influences body weight.¹ One idea is that increased time spent in climate-controlled environments has led humans to expend less energy for thermoregulation. The human thermoneutral zone is the range of ambient temperatures required for a healthy adult to maintain core body temperature without expending energy beyond normal basal metabolic rate.^{2–4} Although the thermoneutral zone varies widely by individual, disease state, age, sex, body composition, and clothing,⁴ Kingma *et al.* have defined a functional thermoneutral zone.³ The functional thermoneutral zone of a clothed person performing seated office work ranges from 14.8°C to 24.5°C.³ Evidence from mammalian model organism studies suggests that the thermal environment influences food intake, with increased food intake at ambient temperatures below the thermoneutral zone⁵ and decreased food intake at temperatures above the thermoneutral zone, even in acute exposures.⁶

Recent evidence in humans is limited by extreme temperatures or physical activity, limited ambient temperature ranges, or lack of randomization;^{7–8} thus, our ability to draw conclusions is limited. While there has been some exploration of the effects of cold exposures^{9–12} and exploration into adaptive thermal comfort and building standards,^{13–17} to what extent small increases above the thermoneutral zone may influence caloric consumption is largely unexplored.

Based on pilot data collected in summer 2014,¹⁸ we hypothesized that exposure to mild temperatures above the thermoneutral zone would decrease food intake in a sedentary office environment among young women. To test this in a pilot randomized crossover trial, we recruited female participants from the same geographic areas and randomized them to thermoneutral (control) or warmer (experimental) conditions to conduct routine office work for 2 workdays in a controlled environment. We estimated differences in caloric intake, assessed changes in thermoregulation, and assessed comfort and productivity.

Methods

Trial design and overview

We implemented a randomized, controlled, crossover design to determine whether food intake differs in thermoneutral or warmer environments. Twenty-five women (aged 19–35 years) were first randomized to either a thermoneutral or a warmer condition for 7 hours and then returned after approximately 1 week for the other condition. Participants worked independently during the day under the limited knowledge that the temperature in the office was modified. All food was provided. The participants were allowed snacks throughout the day and 1 hour to consume lunch. Food intake was measured. At baseline, midday, and the end of day peripheral temperature was assessed by thermal images and thermal comfort and

appetite were assessed by questionnaires. Data collection occurred between May and October 2015 and stopped when all participants completed both conditions. This study was registered with [Clinical-Trials.gov](https://clinicaltrials.gov/ct2/show/study/NCT02507310) (NCT02507310) and was approved by the UAB Institutional Review Board (X141114013).

Participants

The sample size ($n=25$) was based on a pilot study.¹⁸ A sample size of 25 could achieve 80% power to detect a 0.6 standard deviation of paired differences with a significance level of 0.05 using a two-sided paired t-test. Power was calculated using PASS 14 Power Analysis and Sample Size Software (NCSS, LLC, Kaysville, Utah, USA). Researchers recruited participants through flyers placed in common areas (communal eating areas, parking decks, libraries, academic buildings, and telephone poles) on the downtown campus of the University of Alabama at Birmingham. Potential participants were screened over the phone for initial eligibility by use of a questionnaire (Supporting Information). Women aged 19–35 years of all races and ethnicities were eligible. After the trial commenced, the age range was extended to 37 years to accommodate recruitment. Exclusion criteria were food allergies or dietary restrictions; body mass index (BMI) < 18.5; significant weight loss or gain defined as >5% of body weight in the past 6 months; <3 months postpartum or breastfeeding; current smoking; any major medical condition; history of eating disorders; use of medications that could affect heat tolerance, blood pressure, or appetite; and any potential conflict of interest like knowledge of the study parameters or being involved in the same training programs as the principal investigators.

Randomization and blinding

The participants were told little of the study's objectives during the phone screening and reminder calls to minimize influencing their behavior. They were informed that the general interest was the effect of temperature (19–27°C, 66–81°F) in an office setting. They were instructed to bring deskbound tasks, such as books to read and devices or a laptop to use at the provided desk. Additional puzzle books and magazines not targeted at food, recipes, or cooking were also available. At the debriefing at the end of the second day, the participants were fully informed that measured food intake was one of the outcomes.

A simple randomization using a computer-generated sequence of random numbers resulted in 12 women in the sequence with the warmer condition first and 13 women in the sequence with the control condition first. Participants were enrolled and scheduled based on the calendar days that best met their personal schedule (resulting in experimental sequence $n=11$ WC sequence and $n=14$ CW sequence due to last minute participant scheduling changes). They were assigned to interventions to receive first either the warmer 26–27°C (79–81°F) or the control 19–20°C (66–68°F) environment based on the order of the calendar days when they scheduled and only after confirmation the day before participation.

To adjust the thermal conditions and accommodate changes in the schedule, the researchers were aware of the randomization scheme but did not reveal them to the participants until the debriefing, even if directly asked. If directly asked, the researcher reminded the participants that they would be informed at the end of the second day.

Experimental procedures

The exposure was 7 hours in each thermal condition on 2 separate days with a washout period of approximately 1 week. Participants were instructed to fast for 12 hours before their visit and to wear standard clothing each day, defined as socks, closed-toed shoes, typical underwear, long pants, and the provided t-shirt. Peripheral temperature was measured after consent and after 30 minutes in a resting state in nonexperimental conditions before the participant entered the experimental office (baseline), after 3.5 hours of exposure in the office immediately before lunch (midday), and after 7 hours of exposure (end of day) as shown in Figure 1.

A thermostat was used to control the thermal environment. Room temperatures were verified with HOBO® Pendant temperature/light data loggers (Onset Corp. UA-002-64; 2 in the simulated office and one outside the building) that took temperature measurements every 1 min.¹⁹ These monitors can detect temperatures ranging from -20 to 70°C with accuracy of 0.47°C and resolution of 0.10°C at 25°C.⁸ An average SD of 0.04°C was shown between 4 monitors in the same controlled indoor location over a 5-day period.¹⁹

Participants followed the same protocols each day with 2 exceptions. At the start of their first day, they went through the consent and demographic questionnaire. At the end of the second day, they were debriefed and had height and weight measured. The experimental protocol was as follows. At the start of the day, the participants completed an early morning survey in the nonexperimental room. After 30 minutes in the nonexperimental room, a baseline thermal image was taken as described below. The participants then entered the office space, were notified of the available snacks and water, and were instructed to work on what they brought with them. Snacks (prepackaged single-serving brownies, peanuts, and cheese crackers) and bottled water were available throughout the day. Participants were encouraged not to leave the room and were escorted to the restroom upon request. Time out of the thermal conditions was recorded. Participants lacked certain adaptive opportunities as they wore standardized clothing, were unable to change their activity level nor the temperature or air flow in the room.

After 3.5 hours, participants were given the midday questionnaire and a second thermal image was taken. Then lunch (family-sized lasagna convenience meal, ice cream, napkins, plate, bowl, and utensils) was provided. The meal was provided in excess and the participants were given 1 hour to eat. Participants were instructed to eat at their leisure and to then continue working on their tasks.

After 7 hours, the participants completed an end-of-day survey and were reminded of their next appointment before being escorted out of the office. At the end of the second day, height and weight were measured by trained personnel privately in a laboratory using a stadiometer and calibrated scale to calculate BMI as kg/m². The participants were informed that the study objectives were to measure food consumed by weighing the food presented and food waste.

Food and remains (kg) were measured before and after presentation to participants. This weight was compared to known calorie contents from bomb calorimetry verifications.²⁰

Calorie content on an average of 3 samples of each food item presented was estimated by the UAB Nutrition Obesity Research Center core laboratory.

No changes were made to the trial outcomes after the trial began.

Estimation of peripheral temperature

Infrared thermal images (camera: FLIR T300) of the core inner canthus of the eye (core temperature estimate) and third nail bed (peripheral temperature estimate) were taken at baseline (30 minutes after arrival, although temperature was not measured during this time), after 3.5 hours of exposure before lunch, and at the end of the 7-hour stay. Care was taken to ensure that images were taken at a standardized distance (0.9 m, or 3 ft), that hands were kept separate from the body or other surface that might influence measurement for at least 5 min before imaging, and that potential covariates (food or drink intake that morning, caffeine intake, physical exertion, hot showers, and whether they were wearing acrylic nails or polish, makeup, or lotion) were collected via questionnaire. These methods are described in detail in Bernhard et al. 2015.¹⁸

Demographic questionnaire

Questions on standard demographics like age, income level, and education level were asked. Questions were also included on menstrual cycle and hormonal birth control usage because those factors could affect thermophysiology and study outcomes. Questions to estimate heat exposure and potential acclimation included whether participants had used air conditioning in their residence, time spent at a location other than home and whether that location was air conditioned, and time spent outdoors. Other questions relied on self-report of typical exercise and exercise in the last 2 days. Questions related to typical appetite, taste, and eating patterns were drawn from the Simplified Nutritional Appetite Questionnaire (SNAQ).²¹

Early morning, midpoint, and end-of-day questionnaires—Thermal preference, comfort, and acceptability were assessed through questionnaires developed from the Thermal Comfort Survey Questionnaire^{22,23} administered at baseline, midday, and the end of the day. The participants were asked to respond to the sensation they felt on a 7-point scale (1 cold to 7 hot), their perception of comfort in the current thermal environment on a 6-point scale (1 very comfortable to 6 very uncomfortable), and whether the current temperature was acceptable or unacceptable. Questions relating to hunger, satiety, and appetite were also assessed at these time points with visual analogue scales.^{24,25}

To assess whether a major shift in stress or optimism occurred during the washout period and to deflect attention from the temperature and appetite questions, additional questions were added to the early morning and midday questionnaires. Questions on level of optimism drawn from the Life Orientation Test-Revised (LOT-R) were added to the early morning questionnaire.²⁶ Perceived stress was assessed through questions from the Perceived Stress Scale (PSS) added to the midday questionnaire.²⁷

Productivity was assessed through questions on the end-of-day questionnaire (available upon request). Participants were asked about the nature of their work (academic, typical daily

projects, special projects, other), how they would rate their productivity on a scale of 1 to 5 (considerably more to considerably less productive), whether they met their typical daily objectives and why, quality of work (higher quality, same, or lower quality compared to typical), and whether they found the thermal environment highly distracting, moderately distracting, or not distracting from their work.

Data organization: entry, cleaning, and storage

For the primary outcome (food weight), 2 individuals independently entered the data and compared the entries. All other data were entered by one individual, and a second individual independently entered 5% and checked for errors. There error rate for all data entry was <5%.

Data analysis

The demographic variables were summarized as mean and standard deviation (SD) for continuous variables and frequency for categorical variables based on the randomized sequence. For the comparison between 2 sequences, the nonparametric Wilcoxon test was used for continuous demographic variables and Fischer's exact test was used for categorical demographic variables. All statistical analyses followed the standard methods for a 2-by-2 crossover design.²⁸ Briefly, a two-sample t-test was used to test the potential carry-over effects. Given no carry-over effects existed, a mixed effect model was used to compare the calorie intake between 2 conditions, controlling for sequence and period effects. Considering BMI and the peripheral temperature at midday could be correlated with calorie intake, these 2 covariates was also included in the model. This analytical model was prespecified in the beginning of the study and conducted to examine the primary outcome, the calorie intake between 2 conditions. The McNemar test was used to test the difference of proportions of comfort or productivity outcomes between conditions. An intent-to-treat (ITT) strategy was conducted as our primary analysis; while a per-protocol analysis was also conducted as the sensitivity analysis, in which the participants were grouped as their true sequence. Sensitivity analysis was also conducted by excluding a participant with high BMI (>60) from the analysis.

PSS, SNAQ, and the LOT-R were scored based on instructions in original respective articles.^{21,26,27} Maximum daily temperatures (°F) in the 14 days before each individual's day of participation were downloaded from the Birmingham Airport Stationary monitor from NOAA to use as an objective estimate of acclimation. All analyses were conducted using SAS 9.4 (Cary, NC).

Results

Study population

Participants were recruited and included as shown in Figure 2 with two participants not following randomized sequence due to scheduling changes (n=11 WC sequence and n=14 CW sequence as experimental sequence). Demographic variables did not differ significantly between the 2 randomized sequences as shown in Table 1. The washout period averaged 8.9 days (range: 4–21 days). There were no significant differences between the groups in

measures that may affect acclimation, even hormonal birth control usage ($p=0.58$), as shown in Table S1. No participants scored less than 14 on the SNAQ, the cutoff for risk of weight loss, and there were no significant differences between the groups. There were no measured harms or unintended effects.

Study conditions

Temperature conditions were successfully controlled. The average temperature in the warm experimental condition was $25.8 \pm 0.7^{\circ}\text{C}$ (range: 24.5 to 27.3°C) and that in the control condition was $20.0 \pm 0.8^{\circ}\text{C}$ (range: 15.5 to 21.3°C).

Main effect: food intake in the different thermal conditions

As shown in Table 2, the results of the mixed model under ITT showed that participants ate on average 357 (95%CI: 57, 657) kcal more in the control condition than in the warm condition, controlling for BMI, the peripheral temperature at the midday, and potential sequence and period effects ($p = 0.0219$). Peripheral temperatures differed in the 2 conditions; overall, peripheral temperatures were higher in the warm condition (Table S2). No effect on total daily food intake was found in models examining the lunchtime meal alone (lasagna and ice cream only), estimates of acclimation (average temperature in the 14 days preceding participation), outdoor temperature on day of participation, or the luteal phase of the menstrual cycle. For 8 individuals, daily maximum ambient outdoor temperature differed significantly before the 2 days of participation and was averaged. In addition, models examining specific type of food showed no significant difference in type of food by condition. Similar results were also observed using a per-protocol analysis, as shown in the Table 3. Sensitivity analysis excluding the participant with very high BMI (>60) yielded very similar results (Tables S3 and S4). The conclusion remains the same that participants ate less in the warm condition, adjusting for BMI and peripheral temperature.

Secondary Outcomes: Thermal comfort and Productivity

At the midday, 96% of the participants ($n=24$) reported being comfortable in the warm condition, whereas only 32% ($n=8$) reported comfort in the control condition ($p=0.0002$). Participants reported being as productive or more productive than usual in the warm condition ($n=22$, 88%), whereas only 48% ($n=12$) reported these levels of productivity in the control condition ($p=0.002$).

Discussion

Participants ate fewer calories in the warm condition than in the control condition but reported being comfortable and maintaining or exceeding their typical daily productivity. The survey results suggest that the control thermal environment may have been below the thermoneutral zone for these participants, while the warm environment may have been closer to the thermoneutral zone. These results are consistent with findings from other studies suggesting that women perceive the thermal environment of typical office settings as cold.^{29–33} and consistent with findings in men related to adaptive thermal comfort.³⁴

Adaptive thermal comfort relies on data from field studies, as opposed to chamber studies, and supports the idea that people will respond to restore their comfort when a change occurs.^{13–15} Thermal comfort depends on the individual's preference, clothing, activity, acclimation, and the adaptive approaches consider the opportunity to adapt through behavioral adjustments whether personal, technological, or cultural (i.e. changing clothes, adjusting thermostat, posture, or air movement).^{13–15} In addition to the behavioral mechanisms, adaptive thermal comfort is possible through physiological and psychological adaptive mechanisms as Schweiker and Wagner outline in the adaptive thermal heat balance model.³⁵ Physiological adaptations may include genetic adaptations over generations or acclimation over weeks while psychological adaptations may include relaxing indoor climate expectations.³⁶ Studies of adaptive thermal comfort and productivity have been well documented^{13–15} with a recent review highlighting the variance in comfortable temperatures and the dissatisfaction with thermal comfort leading to loss of productivity.³⁷ Tanabe, Haneda, and Nishihara found objective measurement of office work performance was correlated with perceived thermal satisfaction.³⁸ Schellen *et al.* explore the effects of moderate temperature drift on thermal comfort and productivity in young adults (22–25 years old) and older subjects (67–73 years old).³⁹ Productivity and thermal comfort could be further explored following Akimoto *et al.* exploring task ambient conditioning to measure the immediate thermal environment, worker behavior, thermal comfort, and feelings of fatigue.⁴⁰ The present study also suggests that manipulation of the thermal environment may be an acceptable intervention to explore further for reducing food intake, potentially leading to weight loss if energy expenditure does not also go down. There may be additional value in reducing building energy usage in the summer¹⁴ and increasing comfort while not affecting productivity, although increasing the temperature too high could be counterproductive.¹³

While the purpose of this study was not to understand the mechanism, from the literature we understand that thermoregulation is integrated in the hypothalamus, the same area of the central nervous system that regulates food intake.⁴¹ Behaviors relating to food intake are complex; emotions, boredom, and stress may all acutely influence food intake. Participants in this study were not at risk for weight loss, and perceived stress was not significantly associated with the main outcome.

Small sample size and large variance likely hindered our ability to detect a significant difference between thermal conditions without adjusting for other factors. In the power and sample size estimation, we expected the difference could be 0.6 standard deviations between the 2 conditions, for which we could achieve 80% power with the current sample size. However, the observed difference was only 0.13 standard deviations, possibly due to underestimated variance. Nevertheless, our results provide valuable variance and effect estimates for future studies with similar designs. The results were acute; therefore, they may not persist after study participation or upon the participants learning that temperature may influence food intake. In addition, compensation in either food intake or activity after the study may have been affected, although objective measurement of ad libitum food intake through the gold standard of doubly labeled water or physical activity by accelerometers was beyond the scope of this study. Also, the results are not generalizable to the social eating settings many people experience in an office, because the participants ate lunch alone in a closed room.⁴² The single-serving packaging of snacks may have influenced the amount of

snacks consumed.⁴³ Further investigation into food preferences in altered ambient conditions is needed. Sleep habits were not assessed for the nights preceding participation and may have influenced food intake. The peripheral temperature at the end of the day may have been influenced not only by the 7-hour exposure but also by effects of circadian rhythm on thermophysiology, metabolism, and core body temperature.⁴⁴⁻⁴⁶ The accuracy of predicting phase of menstrual cycle (luteal versus nonluteal) based on self-report is limited and may have effects on thermosensitivity and core temperature.⁴⁷ The control condition may have been too cold for the normal-weight participants as noted by their discomfort. This is not surprising as thermoneutral and thermal comfort zone ranges vary greatly by individual² as well as in light of the established literature on adaptive thermal comfort.¹⁵ Further investigation is needed to clarify these results and overcome these limitations.

In our previous study, after control for thermal condition, gender, and BMI, the participants' peripheral temperature was significantly associated with caloric intake ($p = 0.002$), suggesting a mediating effect.¹⁸ The results of the present study did not suggest peripheral temperature as a mediating factor. We were able to maintain room temperatures within desirable ranges, and the participants' peripheral temperatures differed in the 2 conditions, with higher peripheral temperature in the warm condition. This was consistent with the hypothesis that the body would try to dissipate heat in the warm condition as well as the survey results of feeling warmer in the warm condition. This suggests that the warm condition may be within this population's thermoneutral zone and the control condition may have been too cold to fall within the thermoneutral zone of some. This objective measure of peripheral temperature had no additional predictive power for food intake. We acknowledge the limitations of detection of the thermal camera and the limitations of using skin surface temperature as a proxy for peripheral temperature.^{48,49} Using a proxy for body temperature may have been influenced by BMI and factors such as caffeine or exertion, which could contribute to why peripheral temperature was not a strong predictor of food intake. In addition, comparisons to and conclusions drawn from the 2014 lunchtime study may be limited as a result of differences in exposure time (2 vs. 7 hours), type of food available (cheese pizza vs. lasagna, ice cream, and snacks), population (men and women vs. women only), seasonality (April-May vs. June-October), and additional experimental controls (12-hour fasting prior to participation, etc). The crossover design of the present study may have affected the ability to see differences seen in the parallel group design that may have been affected by BMI, age, or factors specific to each period.

In conclusion, this study provides preliminary evidence supporting the hypothesis that food intake is acutely influenced by ambient temperature in young women. It is supportive of known results related to productivity and comfort in this office setting. This evidence may be considered with extensive further research on altered ambient temperature as an avenue for reduced food intake and ultimately weight loss or prevention of weight gain.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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STUDY IMPORTANCE QUESTIONS

What is already known about this subject?

- Recent epidemiologic studies suggest that ambient temperature may influence human energy intake and body weight.
- Evidence from mammalian model organism studies suggests that the thermal environment influences food intake: food intake is increased in animals housed at temperatures below the thermoneutral zone and decreased in animals housed at temperatures above the thermoneutral zone, even in acute exposures.
- Recent evidence in humans is limited by studies with small sample sizes, that often involve only men, that involve extreme temperatures or physical activity, that have limited ambient temperature ranges (mainly focusing on cold exposure), or that lack randomization; thus, the ability to draw conclusions in humans is limited.

What does your study add?

- This study was conducted in young women (aged 19–37) in a controlled randomized crossover design in a workplace setting.
- The study examines the extent to which small changes in thermal exposure may influence energy intake, which is largely unexplored in humans.
- The study also examines the feasibility of manipulating ambient temperature as an applied intervention, considering factors such as comfort and productivity.

Figure 1:
Study Design Flow Diagram

Figure 2:
CONSORT Flow Diagram

Table 1.

Demographic Variables of the Participants by Intent to Treat Sequence (WC intended to receive warm condition first, CW intended to receive control condition first)

	WC	CW
No.	12	13
Age, y		
mean $\pm$ SD	23.8 $\pm$ 4.6	23.9 $\pm$ 5.3
Range	(19–33)	(19–37)
Categorical Variables, No.		
Race or Ethnicity		
Black or African	7	4
White or European	3	5
Other	2	4
Highest Level of Education Completed		
High School Diploma or GED or High School Equivalence Certificate	1	2
Post-Secondary Certificate (awarded for training completed after high school for a vocation or trade)	1	0
Some College Courses or Associates Degree	7	5
Bachelor's Degree	3	3
Graduate Degree	0	3
Employment Status		
Student	4	7
Employed (full or part-time)	3	1
Unemployed	1	2
Student and Employed	4	3
Pre-tax Household Income		
Less than \$20,000	6	7
\$20,000 to \$49,999	3	2
\$50,000 to \$74,999	0	1
\$75,000 or more	3	3
Relationship Status		
Married	0	1
Single	12	11
Widowed	0	1
Body Mass Index (BMI)		
Average $\pm$ SD	30.9 $\pm$ 10.3	25.5 $\pm$ 3.5
BMI Categories, No.		
Normal Weight	3	7
Overweight	5	4
Obese	4	2

Table 2.

Main Effects of Total Daily Food Intake (kcal) by intent-to-treat analysis

Parameter	Estimate	95% Confidence Intervals	p Values
Intercept	−1633	(−2927, −339)	0.0157
Sequence (CW)	237	(−101, 574)	0.1597
Period (1)	102	(−101, 305)	0.3072
Control Condition	357	(57, 657)	0.0219
Body Mass Index	66	(44, 88)	<0.0001
Peripheral temperature at midday	38	(5, 72)	0.0268

Note. CW received control condition first.

Table 3.

Main Effects of Total Daily Food Intake (kcal) by per-protocol analysis

Parameter	Estimate	95% Confidence Intervals	p Values
Intercept	−2070	(−3734, −405)	0.0171
Sequence (CW)	214	(−104, 532)	0.1764
Period (1)	70	(−136, 276)	0.4875
Control Condition	498	(57, 938)	0.0286
Body Mass Index	62	(41, 82)	<0.0001
Peripheral temperature at midday	57	(8, 105)	0.0239

Note. CW received control condition first.