The Effect of Antiperspirants on Whole Body Sweat Rate and Thermoregulation

a report by
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It is well-established that the evaporation of sweat from the human body surface is the main mechanism by which heat balance is maintained following a rise in core body temperature. Since the introduction of the first brand-name antiperspirant in the US in the early 1900s, antiperspirant products designed to control underarm wetness have grown to represent one of the largest cosmetic categories in most global markets. However, although axillary sweating only constitutes less than 1% of whole body sweat rate, consumers, particularly those in warmer climates, have articulated the concern that antiperspirants may interfere with the body's natural cooling process.

To investigate this, carefully designed experiments were undertaken that measured the effects of axillary antiperspirant application on whole body sweat rate and core body temperature following a regime of exercise-induced heat stress in a hot environment in human volunteers. The data shows clearly that, although antiperspirant prevents sweat production in the axillary area, this does not impact on the ability of the body to thermoregulate following a rise in core body temperature. Thus, consumer questioning over this aspect of antiperspirant use appears to be unwarranted.

Introduction

The primary function of eccrine sweat production is thermoregulation. Evaporation of sweat from the body surface helps to maintain heat balance following a rise in core body temperature. Under normal circumstances, an individual will secrete about one litre of sweat per day from approximately three million eccrine sweat glands distributed over the body surface. This volume can increase to two or three litres during moderate exercise and 10 litres or more during heavy exercise in a hot environment. In contrast, the volume of sweat secreted per day in the axillary region averages between 1ml to 10ml, originating from approximately 25,000 sweat glands per axilla. Although axillary sweating constitutes less than 1% of whole body sweat rate, a consumer question (particularly in hot countries) is whether reducing this volume by the use of antiperspirant products interferes with the body's natural cooling process. To investigate this, the effects of axillary antiperspirant application on whole body sweat rate and core body temperature changes were observed following exercise-induced heat stress in a hot environment.

Methods

Two groups of healthy male subjects of similar age and body surface area were recruited. All subjects provided informed consent and were screened for cardiac/respiratory-related problems prior to the study. Workloads for each individual were determined prior to testing and defined as the ability to maintain a 45-minute duration exercise regime on a cycle ergometer with the heart rate not exceeding more than 10 beats per minute below their maximum heart rate for age (calculated using the Karvonen Formula – the mathematical formula that uses maximum heart rate minus resting heart rate to determine target heart rate – as 220 minus age in years).

Subjects completed two 45-minute cycle trials. An initial deodorant trial was conducted following a 14-day washout period during which subjects refrained from using any underarm antiperspirant product. A second antiperspirant trial was conducted following seven days of consecutive application of a standard marketed antiperspirant product. For the initial trial, subjects were requested to keep a food and physical activity diary so that they could replicate dietary intake and exercise on the night and morning prior to the second trial.

To minimise potential diurnal fluctuations in sweat rate, all trial subjects arrived for the study at the same time of day and ingested 500ml of water. Each subject (wearing a towel only) was then weighed to the nearest gram and asked to don shorts and trainers before entering the environmental chamber controlled for temperature and humidity (35°C, 20% relative humidity).

A heart rate monitor was attached and an aural thermistor with digital output display inserted into the ear canal. On commencing exercise, the workload was increased to the pre-determined value and maintained for the duration of the test.

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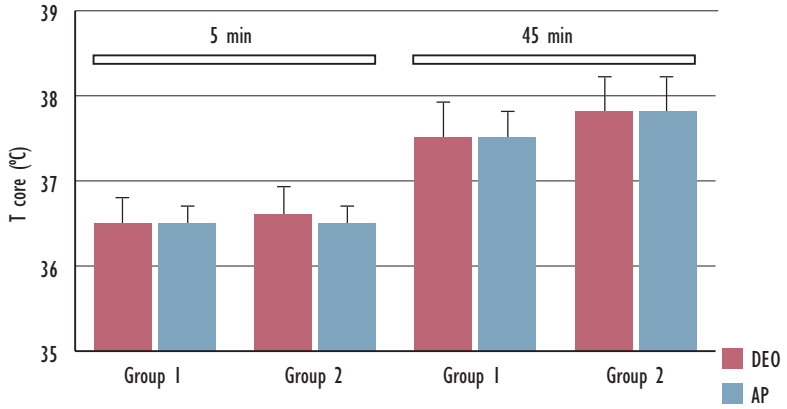
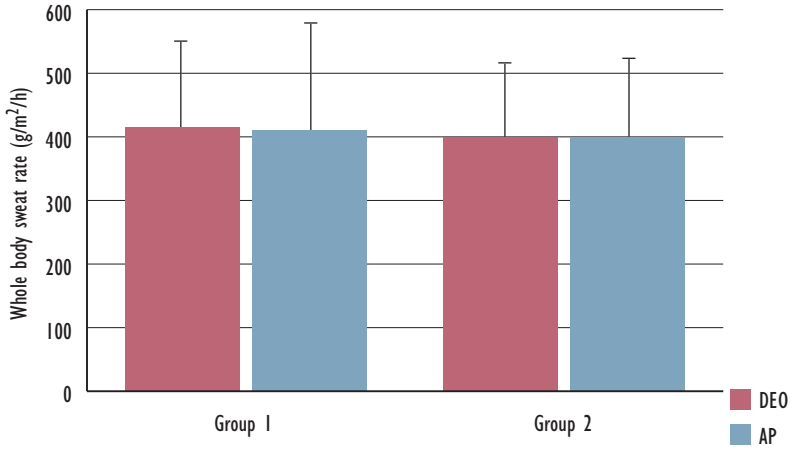
Figure 1: Average Body Core Temperature five minutes and 45 minutes following exercise with antiperspirant and without antiperspirant for two separate subject groups



AP=with antiperspirant; DEO=without antiperspirant. Group 1 and Group 2; mean ±SE.

Figure 2: Whole body sweat rate following 45 minutes of induced heat stress in a hot environment with antiperspirant and without antiperspirant for two separate subject groups



AP=with antiperspirant; DEO=without antiperspirant. Group 1 and Group 2; mean ±SE.

Heart rate and core temperature (T_{core}) were recorded at five-minute intervals. Respiratory gases were collected using standard techniques for three-minute periods starting at 10, 25 and 40 minutes.

At each time point, temperature and humidity readings were recorded using a wet/dry bulb thermometer. The respiratory gas volume was measured and the respiratory fluid loss over the 45-minute period was subsequently determined.

At the end of the 45-minute period, the heart rate monitor and aural thermistor were removed and the subject exited the hot room. Subjects used a second towel to dry themselves thoroughly and were re-weighed to the nearest gram to determine fluid loss via sweating during the study. Whole body sweat loss per hour (g/m^2 per hour) was calculated as the difference between total fluid loss adjusted for body surface area and respiratory fluid loss.

Results

Core Temperature

Group averages for core body temperature after five minutes of exercise – and following 45 minutes of exercise for deodorant- and antiperspirant-treated individuals – are shown in *Figure 1*. As might be expected, the data shows clearly that extended exercise (45 minutes versus five-minute time points) led to an increase in core temperature of approximately 1°C in both groups of individuals. However, within groups, there were no significant differences between core temperatures during antiperspirant and deodorant trials.

Whole Body Sweat Loss

Mean values for whole body sweat loss for Groups 1 and 2 are shown in *Figure 2*. Sweat loss was similar in each group and, more interestingly, anti-perspirant application had no significant effect on whole body sweat loss when compared with deodorant trials.

Discussion

The popularity of underarm antiperspirants derives from their ability to meet one of the biggest personal product needs articulated by consumers; a reduction in underarm wetness. Although antiperspirant usage is confined to the axillary region and is generally no greater than 50% to 60% effective in reducing sweat production at this site, concerns are expressed by some consumers that antiperspirants affect the body's thermoregulatory ability. Such questions most likely originate from the fact that the perception of underarm sweating is strong, which is a consequence of the occluded nature of this body area and the concomitant reduction in the evaporation of sweat. This study now shows that, although antiperspirant prevents sweat production in the axillary area, this does not impact on the ability of the body to thermoregulate following a rise in core body temperature. Thus, consumer concern that anti-perspirant use may interfere with the body's ability to regulate its temperature, appears to be unmerited. ■

Acknowledgement

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This article is continued, with an additional graphic, table and references, on the BBL website supporting this business briefing (www.bbriefings.com/cdps/cditem.cfm?NID=846).