# Popcorn Consumption Leads to Less Hunger and More Fullness Compared to Milk Chocolate

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## 730.1 Abstract

**Understanding the effect of common snack foods on hunger and fullness can help guide food selection in the context of weight control. We compared eucaloric (100 kcal) servings of 94% fat free whole grain popcorn and milk chocolate.**
**Methods: In a counterbalanced cross-over design, 49 women consumed a standard breakfast followed by the snack three hours later. Participants recorded feelings of hunger, fullness, thirst, desire for a snack, and general mood on 11-point scales pre- and post-snack. Standard 9-point hedonic scales were used to assess overall liking, appearance, flavor, texture and satisfaction.**
**Results: Popcorn yielded lower hunger ($p<0.0001$) and greater fullness ($p<0.005$) than milk chocolate. Overall liking and flavor liking were higher for milk chocolate ($p<0.05$), but satisfaction with amount of food was higher for popcorn ($p<0.05$).**
**Conclusions: These results show a 100 kcal portion of popcorn has a greater effect on hunger, fullness, and visual satisfaction than milk chocolate, and suggests popcorn is a more prudent snack choice for weight management.**

## Background

Snacking has become an important component of Americans' eating patterns. Frequency of snacking has increased over the past 30 years based on national data sets showing the 50th percentile of daily eating episodes moving from three in 1977 to five currently. [1] Data from the 2005-06 National Health and Nutrition Examination Survey show that snacks contribute 24% of adults' daily energy intake, approximately 600 kcal/day for men and 400 kcal/day for women.[2]

The influence of snacking behaviors on total energy intake and obesity has not been fully elucidated. Various studies have found that humans do not compensate for energy consumed as energy dense snacks.[3] Forslund et al. found that obese men and women consumed more calories from candy and chocolate snacks than did reference men and women, and that this trend continued with increased snacking frequency.[4] However, the relationship of lower energy dense, higher fiber whole grain snack foods to obesity has not been examined. It is plausible that these healthier snacks do not contribute to obesity and in fact, play a role in supporting weight management and weight loss. For example, consumption of such snacks may help consumers overcome barriers to achieving healthy weight, such as hunger and desire to eat energy-dense snacks in the absence of hunger. Thus, the type of snack consumed appears to be an important element in the overall research effort to prevent and reverse obesity.

## Purpose

To examine the effect on satiety and hedonics of eucaloric 100 kcal portions of 94% fat free popcorn compared to milk chocolate nuggets.

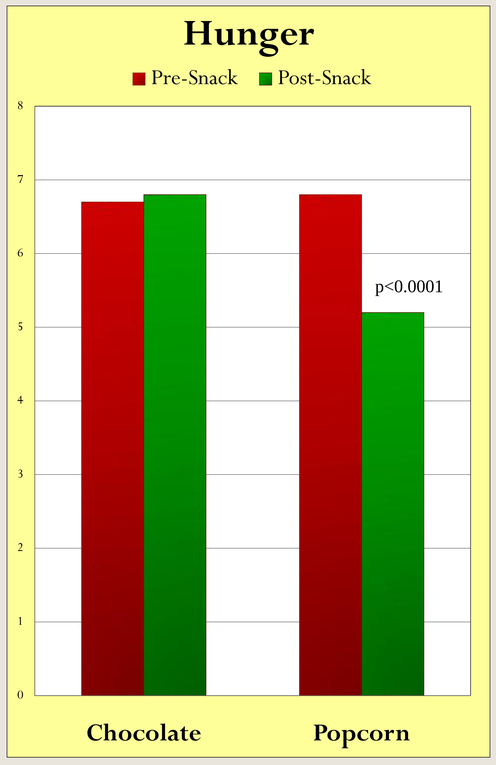
## Methods

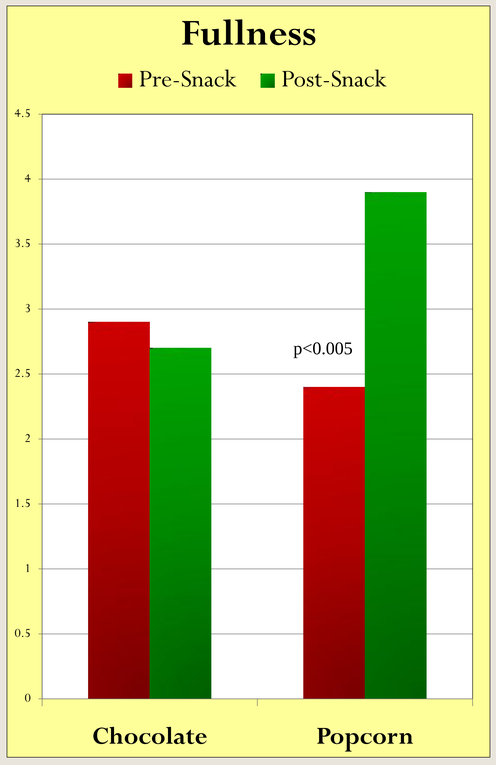
Subjects
- Forty nine normal weight women (BMI 18.5 – 24.9) between the ages of 20 and 50 years.

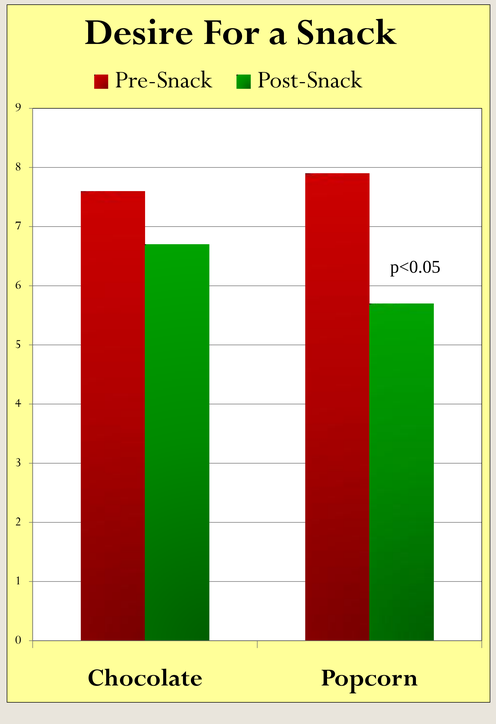
Data Collection
- On two separate occasions separated by at least one week, participants consumed 100 kcal portions of either 94% fat free popcorn (six cups, 35 g) or milk chocolate (two nuggets, 21 g) in a cross-over, counter balanced design. On the day of the study, after a 12-hour overnight fast, participants reported to the testing facility by 7:30 a.m. to consume a standard 400 kcal breakfast. Participants were allowed to consume water (up to 500 ml) between 8:00 and 11:00 a.m. At 11:30, participants consumed the respective snack with 250 ml water and completed the snack within 15 minutes. Participants recorded feelings of hunger, fullness, thirst, desire for a snack, and general mood on 11-point scales 15 minutes before the snack and 30 minutes after the snack commenced. Standard 9-point hedonic scales were used to assess overall liking, appearance, flavor, texture and satisfaction.

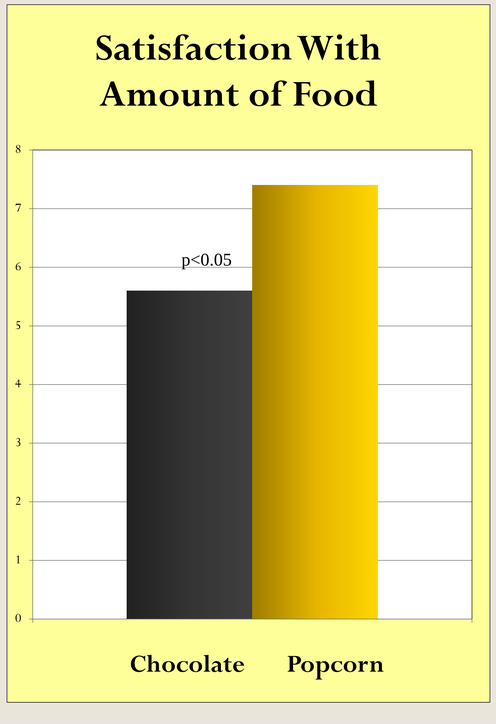
Analysis
- Mean satiety and sensory scores pre-snack and post-snack were compared using mixed model ANOVA with time, sample, their interaction and panelist as effects.

## Results




## Discussion

Our results showing that popcorn is more satiating than chocolate candy are consistent with those of Holt et al. who determined the satiety index of popcorn to be greater than other snacks and candies tested, including Mars Bar, peanuts, yoghurt, potato chips, ice cream and jelly beans. [5] Low fat popcorn may be a relatively satiating snack based on several attributes. For example, the air incorporated into popcorn may enhance the satiating effect. A previous study found that incorporation of air into a snack food (aerated cheese puffs) led to decreased energy intake compared to the less aerated counterpart of the same snack. [6] Additionally, the low fat, high carbohydrate composition of the popcorn in this study is another potential contributor to its satiating effect. Green et al. (2000) reported that when subjects were fed high carbohydrate or high fat snacks, high fat snacks led to higher energy consumption compared to high carbohydrate snacks.[7] Moreover, the small size of popped kernels may contribute to a lower intake. One study showed that "nibble-size" pieces of a snack compared to "bar-size" pieces of a snack led to a 12% decrease in energy intake.[8]

## Conclusions

A 100 kcal portion of low fat, whole grain popcorn has a greater effect on hunger, fullness and visual satisfaction than milk chocolate. Hunger and the desire to consume a snack are obstacles for individuals trying to manage their weight. This study suggests choosing low fat popcorn instead of chocolate candy can be more effective in overcoming hunger and creating fullness, and therefore, may be an important adjunct for weight management.

## Implications

Because snacking has become an integral component of the typical American eating pattern, helping individuals manage snack choices is imperative. Encouraging satiating, low energy dense, nutrient rich snack choices such as low fat popcorn is a prudent strategy toward improving snacking patterns to support healthy body weight.

## References

1. Popkin BM, Duffey KJ. Does hunger and satiety drive eating anymore? Increasing eating occasions and decreasing time between eating occasions in the United States. *Am J Clin Nutr.* Mar 17 2010.
2. USDA, ARS. Snacks: Percentages of Selected Nutrients Contributed by Foods Eaten at Snack Occasions, by Gender and Age, *What We Eat in America*, NHANES, 2005-2006. 2009; http://www.ars.usda.gov/ba/bhnrc/fsrg. Accessed April, 2010.
3. de Graaf C. Effects of snacks on energy intake: an evolutionary perspective. *Appetite.* Jul 2006;47(1):18-23.
4. Berteus Forslund H, Torgerson JS, Sjostrom L, Lindroos AK. Snacking frequency in relation to energy intake and food choices in obese men and women compared to a reference population. *Int J Obes (Lond).* Jun 2005;29(6):711-719.
5. Holt SH, Miller JC, Petocz P, Farmakalidis E. A satiety index of common foods. *Eur J Clin Nutr.* Sep 1995;49(9):675-690.
6. Osterholt KM, Roe LS, Rolls BJ. Incorporation of air into a snack food reduces energy intake. *Appetite.* May 2007;48(3):351-358.
7. Green SM, Wales JK, Lawton CL, Blundell JE. Comparison of high-fat and high-carbohydrate foods in a meal or snack on short-term fat and energy intakes in obese women. *Br J Nutr.* Oct 2000;84(4):521-530.
8. Weijzen PL, Liem DG, Zandstra EH, de Graaf C. Sensory specific satiety and intake: the difference between nibble- and bar-size snacks. *Appetite.* Mar-May 2008;50(2-3):435-442.

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