**Regular Coffee Consumption Is Associated with Lower Regional Adiposity Measured by Dual-energy X-ray Absorptiometry Among US Women**

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**Sources of Support:**

This project received no financial support.

**Competing Interests and Funding Disclosure:**

The authors have no conflicts to disclose.

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**Word Count:** text: 2650; abstract 295.

**Tables:** 4 tables

**Supplementary**: 4 supplemental tables

**A Short Running Head:** Coffee Consumption and Adiposity

**Abbreviations Used:**

DXA, duel-energy X-ray absorptiometry

FFQ, food frequency questionnaire

BMI, body mass index

NHANES, National Health and Nutrition Examination Survey

Healthy Eating Index 2010, HEI-2010

WC, waist circumference

**ABSTRACT**

**Background:** Coffee is among the most popular daily beverages in the United States. Importantly, coffee consumption has been associated with a lower risk of multiple health outcomes including a reduction in adiposity. Duel-energy X-ray absorptiometry (DXA) is a means to assess body fat and distribution.

**Objective:** The aim of this study was to examine the relationship between coffee consumption and DXA assessed adiposity and distribution.

**Methods:** Cross-sectional data from The National Health and Nutrition Examination Survey (NHANES) were used. Participants were adults aged 20-69 years from the 2003-2004 and 2005-2006 waves. Information on coffee consumption was assessed through the food frequency questionnaire (FFQ) (categorized as: No Coffee, 0-<0.25 cup/day, 0.25-<1 cup/day, 1 cup/day, 2-3 cups/day, ≥4 cups/day). Both caffeinated and decaffeinated coffee consumption were included. Trunk fat and total fat percentage were measured via whole body DXA scans. The association between coffee consumption and body fat were investigated using age-adjusted and multivariable-adjusted linear regression models which accounted for sample weights.

**Results:** Higher coffee consumption was associated with significantly lower total body fat percent and trunk body fat percent in a dose-response manner (all *P* values <.05) among women. Although this dose-response relationship was not significant among men, men aged 20-44 years who drank 2-3 cups per day had less 1.3% (95% CI, -2.7 to 0.1) total fat and trunk fat 1.8% (95% CI, -3.3 to -0.4) than those who did not consume coffee. Furthermore, the association between coffee consumption and body fat percent exhibited for both caffeinated and decaffeinated coffee among women (all p for trend<.001) but not among men (all p for trend>0.05).

**Conclusions:** The present study found a significant association between coffee consumption and lower DXA-measured adiposity. Moreover, a gender difference in this association in the general US adult population was also observed.

**Keywords**: Coffee consumption, NHANES, Body fat, adiposity, gender

**INTRODUCTION**

Coffee is consumed worldwide and has a global consumption that reaches approximately 7 million tons per year.(1) Specifically, it has been estimated that the US coffee drinker consumes about 3 cups a day on average.(1) Such a high quantity and frequency of consumption calls for action to acquire a detailed understanding of the influence of coffee consumption on health. As over a thousand bioactive compounds are contained in coffee, such as caffeine, chlorogenic acids, and diterpenes, potential health effects of coffee have been debated for several years.(2, 3) Some studies suggest that increased caffeine intake may raise blood pressure(4) and promote carcinogenesis of certain malignancies such as urinary bladder cancer,(5) although it should be noted that other studies have not found such associations.(6, 7) However, recent literature has indicated that moderate coffee consumption, defined as three to four cups a day, has a significant risk reduction for type 2 diabetes, cardiovascular diseases, and overall mortality.(8) Moreover, biological pathway analysis between coffee and health outcomes showed a pattern of biomarkers suggesting a beneficial effect of coffee consumption on metabolism and inflammation.(9)

The epidemic of overweight and obesity is a global concern. According to the World Health Organization worldwide obesity has nearly tripled since 1975.(10) In a nationally representative sample of US older adults it was found that body mass index (BMI) had a significant increase from 1999-2000 to 2015-2016 in both men and women.(11) Importantly, being overweight or obese is associated with increased morbidity and mortality.(12) In a recent systematic review and dose response meta-analysis of randomized-controlled trials it was found that increased caffeine intake was associated with reduction in obesity measures in a dose-response manner.(13) Overall, the meta-analysis demonstrated that caffeine intake might promote body weight, BMI and body fat reduction.(13) It has been postulated that the effect of coffee intake on adiposity is regulated via energy expenditure by increasing metabolic rate in control and obese individuals as well as greater oxidation of fat in normal weight participants.(14)

Despite reported associations between coffee intake and obesity measures, some obesity measures, such as BMI and fat percentage measured by bioimpedance, have important limitations. For example, BMI does not differentiate fat mass from muscle and bone (fat-free) mass,(15) and fat percentage does not provide information on fat distribution.(15) Dual energy x-ray absorptiometry (DXA), provides measures on total adiposity, fat distribution and body composition. Therefore, the aim of the present study was to investigate the cross-sectional association between coffee consumption and DXA assessed adiposity and adiposity distribution, in a large representative sample of the US population.

**METHODS**

**Study population**

The National Health and Nutrition Examination Survey (NHANES) study is a series of cross-sectional, complex, stratified, multistage probability surveys using nationally representative samples to estimate the prevalence of health, nutrition, and potential risk factors among the civilian non-institutionalized US population.(16, 17) Each survey participant provided written informed consent, finished a household interview and completed a physical examination at a mobile examination center. We extracted information on sociodemographic characteristics, DXA scan assessment, dietary patterns, medical conditions, and lifestyle behaviors among those who were aged 20-69 years in two waves 2003-2004 and 2005-2006 owing to availability of DXA examination.(18)

**Assessment of exposure**

The NHANES food frequency questionnaire (FFQ), a 124-item food frequency instrument, was utilized to obtain information on past year food and food group consumption patterns.(19)Coffee consumption frequency was assessed in 10 categories, ranging from 0 to 6 or more cups per day, and collapsed into six groups (no coffee, 0-<0.25 cup/day, 0.25-<1 cup/day, 1 cup/day, 2-3 cups/day, ≥4 cups/day). One cup approximately equals to 236.59 mL in the US. Both caffeinated and decaffeinated coffee consumption were included in the current analysis. Individuals who reported no coffee consumption was defined as non-coffee drinkers. The Based on the NHANES FFQ analytical notes, the coffee consumption frequency was transformed into a continuous variable (cups/day) to test the dose-response relationship.(20)

**DXA scan**

The whole body DXA scans were acquired using a Hologic QDR 4500A fan-beam densitometer (Hologic, Inc., Bedford, Massachusetts) following the manufacturer’s protocol.(21) Specific exclusion criteria were used to determine the eligibility of participants.(21) Each DXA scan was reviewed and analyzed by the University of California, San Francisco, Department of Radiology using standard radiologic techniques and study-specific protocols developed for the NHANES. Hologic Discovery software version 12.1 was used to analyze DXA exams and provided body composition data. We derived fat percentage of the trunk (only the trunk area of the human body) and fat percentage of the total body (including head, limbs, and trunk area of the human body) to measure magnitudes and distributions of body fat.

**Covariates**

Self-reported sociodemographic characteristics included age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and others), annual household income (<$25,000, $25,000 to $74,999, and ≥ $75,000), and educational attainment (< high school, high school, and > high school).(22) Lifestyle characteristics included leisure-time physical activity (inactive vs. active), television viewing (hours/day), computer use (hours/day), and the intention to lose/control weight (yes vs. no).(23, 24) Smoking status was defined based on current smoking status and quantities of cigarettes as: never smoking, past < 20 pack-years, past ≥20 pack-years, past without pack-year information, current < 20 pack-years, and current ≥ 20 pack-years.(25) Five prevalent chronic conditions related to excess adiposity were considered: hypertension, high blood cholesterol level, osteoarthritis, coronary heart disease, and type 2 diabetes mellitus.(26) Finally, data on dietary covariates were derived from both FFQ (including consumption of alcohol beverage [beer, liquor, and wine], consumption of hot/ice tea, frequency of sugar-added beverage, and sugar/creamer/milk added to coffee) and 24-hours recall data (including total energy intake and intake of food items to derive the Healthy Eating Index 2010).(27)

**Statistical analysis**

The present analysis used DXA data sets released by NHANES on the Center for Disease Control website, where missing data was not completely random.(18) To avoid bias, multiple imputation was employed at the National Center for Health Statistics as described in the technical documentation available on the above referenced website.(21) Due to the sex difference in body composition,(28) all analyses were conducted separately among men and women. We first calculated the descriptive characteristics of the study population according to coffee consumption frequency among men and women, respectively. Secondly, we used age-adjusted and multivariable-adjusted linear regression models to examine associations of coffee consumption frequency with body fat and their dose-response relationship (*P* for trend). Finally, stratified age-adjusted and multivariable-adjusted linear regression models were carried out according to race/ethnicity. SAS-callable SUDAAN 11.0 (RTI International) was used to account for the complex survey design and a multiple-imputed dataset to reduce bias.(21) Sample weights were adjusted per National Center for Health Statistics recommendations.(29) Sensitivity analyses were conducted among non-smokers and individuals without chronic diseases (cancers, heart disease, stroke and diabetes), respectively. Moreover, we examined associations of body fat percent with caffeinated and decaffeinated coffee consumption, respectively. 95% confidence intervals were calculated. All statistical tests were 2-sided.

**RESULTS**

Characteristics of the participants are presented according to daily coffee consumption frequency among men and women, respectively (**Table 1**). In both men and women, those reported more frequent coffee drinking were older than those reported less frequent or no coffee consumption. There is a distinct pattern of coffee consumption according to race/ethnicity. For instance, non-Hispanic white men (31.6%) are more likely to drink 2-3 cups per day compared with non-Hispanic blacks (13.0%) and Hispanic (16.6%) men, with a similar pattern in women.

Associations of coffee consumption with body fat percent among men and women are presented in **Table 2** and **Table 3** (see all β coefficients in the **Supplemental Table 1-2**), respectively. Although a statistically significant interaction between coffee consumption and age was observed in women (multivariable-adjusted :P=0.042), but not men (multivariable-adjusted: P=0.17). Among men, both the age- adjusted and multivariable-adjusted models demonstrated non-significant associations between coffee consumption and body fat percent, except that men aged 20-44 years who drank 2-3 cups per day had less total fat percentage (β, 1.3 [95% CI, -2.7 to 0.1]) and trunk fat percentage (β, 1.8 [95% CI, -3.3 to -0.4]) than non-coffee drinkers. In contrast, higher coffee intake was associated with significantly lower total body fat percent and trunk body fat percent in a dose-response manner (all *P* values <0.05) among women in age-adjusted models. In addition, after adjusting for the effects of multiple covariates, women aged 20-44 years who drank coffee 2-3 cups per day had the lower total body fat percent (β, -2.1 [95% CI, -3.6 to -0.5]) and trunk body fat percent (β, -2.9 [95% CI, -4.9 to -0.9]) compared with those who did not drink coffee. Among women aged 45-69 years, those who drank coffee ≥ 4 cups per day had lower total body fat percent (β, -2.5 [95% CI, -4.5 to -0.6]) and trunk body fat percent (β, -4.3 [95% CI, -6.7 to -2.0]) compared with individuals who did not drink coffee.

Associations between coffee consumption and body fat percent among women by race/ethnicity (aged-adjusted: P for interaction<0.001; multivariable-adjusted: P for interaction=0.34) were reported in **Table 4**. In the multivariable-adjusted models, a significant dose-response association of higher coffee intake with lower body fat percent were observed among non-Hispanic white women and Hispanic women (all *P* values <0.05), but not among non-Hispanic black women (all P values>0.1). Among non-Hispanic white women, those who drank coffee ≥ 4 cups per day had lower total body fat percent (β, -2.0 [95% CI, -3.5 to -0.5]) and trunk body fat percent (β, -3.5 [95% CI, -5.3 to -1.8]) than women who did not drink coffee

In addition, the associations between coffee consumption and body fat percent were consistent among non-smokers and those without chronic diseases (**supplemental Table 3**). The interaction between coffee consumption and smoking status was significant among men (p<0.001) but not among women (p=0.10). Furthermore, the **supplemental Table 4** indicated that the association between coffee consumption and body fat percent exhibited for both caffeinated and decaffeinated coffee among women (all p for trend<.001) but not among men (all p for trend>0.05).

**Discussion**

In this large representative sample of the US adult population, a dose-response association of higher coffee intake with lower total body fat percent and trunk body fat percent in women but not in men was observed. Moreover, women aged 20-44 years who drank 2-3 cups of coffee per day and women aged 45-69 years who drank coffee ≥ 4 cups per day had the lower total and trunk body fat compared with those who did not drink coffee within their respective age groups. Moreover, associations maintained among non-smokers and individuals without chronic diseases.

A recent meta-analysis found that a higher coffee intake was significantly associated with an increased risk of overweight or obesity as defined by body mass index (BMI) in women. Yet there was a suggestive inverse association between coffee intake and central obesity as defined by waist circumference (WC) in men.(30) The difference between these findings and the present study are likely owing to the differing measures of adiposity. BMI is a poor measure of adiposity in comparison to DEXA since it cannot provide information on fat distribution (e.g. trunk adiposity). Furthermore, the numerator in the BMI calculation ‘total body weight’ does not distinguish between lean and fat mass. Therefore, an individual with high levels of lean mass may be classified as having a high BMI; whereas an individual who is of normal weight but has excess body fat may be classified as having a normal BMI. Moreover, WC is a simplistic, although accurate, measure of waist size whereas DEXA measured trunk adiposity is the measurement of the trunk area of the human body. It is indeed plausible that coffee consumption has differing associations with WC and trunk adiposity. Our work enriches the current body of literature by showing that an association does exist between coffee consumption and adiposity in a large sample of US adults using a precise measure of adiposity. Acheson et al. showed that coffee administration was associated with increased metabolic rate in randomized individuals.(14) In addition, Koot and Deurenberg,(31) showed that body temperature was also increased through coffee administration, mainly owing to caffeine possibly simulating the individual’s metabolism. Similarly, Roberts and his colleagues demonstrated the regular hot tea drink was associated with reduce fat levels at population level.(24) Interestingly, animal trials utilizing interventions with decaffeinated coffee have shown that decaffeinated coffee aids in the prevention of weight gain through reversing high-fat diet-induced fat accumulation.(32) These findings suggest that other than caffeine, there are other bioactive compounds in coffee that regulate weight and could, potentially, serve as anti-obesity compounds. For example, Murase et al. showed that administration of coffee polyphenols to mice with a high-fat diet prevented weight gain, enhanced metabolic rate, and increased expression of *UCP2* mRNA in adipose tissue.(33) Moreover, *UCP2* is widely expressed in the human body being an important regulator of energy balance.(34)

In the present study, sex differences in the association between coffee consumption and body fat were observed. These results confirmed differential sex-specific findings reported in previous studies assessing associations between coffee consumption and adiposity metrics. A recent study from Korea showed coffee consumption to be associated with a lower risk of metabolic syndrome (characterized by a clustering of cardiovascular risk factors, including abdominal obesity, elevated blood pressure and blood glucose, and dyslipidemia) in women, but not in men.(35) In addition, Grosso et al reported that high coffee consumption was inversely associated with WC, hypertension, and triglycerides in women, but not in men.(36) However, the underlying mechanisms in these sex differences are still unclear, one study suggested that men and women differ in their responses to caffeine and that these differences might be mediated by changes in circulating steroid hormones.(37) Sex steroid hormone plays a crucial role in regulating the amount and distribution of adipose tissues.(38) These data support the present finding that regular coffee consumption may ameliorate central obesity among the elderly and women. The effect is likely to be effectuated through the regulation of sex steroid hormones.

Interestingly, it should be noted that women aged 20-44 years who drank 2 to 3 cups of coffee per day had the lowest levels of adiposity whereas in women aged 45-69 years those who drank greater than 4 cups of coffee per day had the lowest levels. The exact reason why this age difference is observed is not yet clear and further research of an experimental nature is required. Moreover, a significant dose-response association of higher coffee intake with lower body fat percent was observed among non-Hispanic white women and Hispanic women, but not among non-Hispanic black women. Nevertheless, the interaction between race/ethnicity and coffee consumption was not significant in the multivariable model.

Clear strengths of this study include the large representative sample of US adults and the precise measure of adiposity using DXA. Furthermore, the robustness of the association investigated in this study can be supported by a series of sensitivity analyses. However, findings must be interpreted in light of the study limitations. First, the study was cross-sectional in design and the temporal relationship cannot be established. However, one can speculate weight status is unlikely to influence coffee consumption behavior. Second, the data collection followed the NAHENS study protocol, therefore analyses were limited to using self-reported coffee intake. Similarly, data were limited to a consideration of bioactive compounds in the body (slow metabolizing person vs. fast metabolizing person). Nonetheless, the present analyses represent one of the few explorations of coffee consumption and can be used to inform future research on developing novel approaches that aim to reduce excess adiposity at the population and individual level.

In conclusion, in this large representative sample of US adults, coffee consumption was associated with lower adiposity as measured by DXA, particularly among women. These findings suggest that coffee and/or its effective ingredients could be integrated into a healthy diet strategy to reduce the burden of chronic conditions related to the obesity epidemic. Further research could aim to identify the effective constituents(s) and their granular mechanism of action linking coffee to obesity.

**Acknowledgments**

Statement of authors’ contributions

C.C., L.Y. and S.L. designed research; C.C., L.Y. and S.L. conducted research; C.C analyzed data; C.C., T.X., L.Y. and S.L. wrote the paper. C.C. and S.L. had primary responsibility for final content. All authors read and approved the final manuscript.

**REFERENCES**

1. Butt MS, Sultan MT. Coffee and its consumption: benefits and risks. Crit Rev Food Sci Nutr. 2011 Apr;51:363-73.

2. Jeszka-Skowron M, Zgoła-Grześkowiak A, Grześkowiak T. Analytical methods applied for the characterization and the determination of bioactive compounds in coffee. European Food Research and Technology. 2014 2015/01/01;240:19-31.

3. Kim Y, Je Y, Giovannucci E. Coffee consumption and all-cause and cause-specific mortality: a meta-analysis by potential modifiers. Eur J Epidemiol. 2019 Aug;34:731-52.

4. Noordzij M, Uiterwaal CS, Arends LR, Kok FJ, Grobbee DE, Geleijnse JM. Blood pressure response to chronic intake of coffee and caffeine: a meta-analysis of randomized controlled trials. J Hypertens. 2005 May;23:921-8.

5. Hong X, Xu Q, Lan K, Huang H, Zhang Y, Chen S, Chi Z, Lin J, Zhou Y, Wu W, et al. The Effect of Daily Fluid Management and Beverages Consumption on the Risk of Bladder Cancer: A Meta-analysis of Observational Study. Nutr Cancer. 2018 Nov-Dec;70:1217-27.

6. Dai ZW, Cai KD, Li FR, Wu XB, Chen GC. Association between coffee consumption and risk of bladder cancer in a meta-analysis of 16 prospective studies. Nutr Metab (Lond). 2019;16:66.

7. Hashemian M, Sinha R, Murphy G, Weinstein SJ, Liao LM, Freedman ND, Abnet CC, Albanes D, Loftfield E. Coffee and tea drinking and risk of cancer of the urinary tract in male smokers. Ann Epidemiol. 2019 Jun;34:33-9.

8. Poole R, Kennedy OJ, Roderick P, Fallowfield JA, Hayes PC, Parkes J. Coffee consumption and health: umbrella review of meta-analyses of multiple health outcomes. BMJ. 2017 Nov 22;359:j5024.

9. Hang D, Kvaerner AS, Ma W, Hu Y, Tabung FK, Nan H, Hu Z, Shen H, Mucci LA, Chan AT, et al. Coffee consumption and plasma biomarkers of metabolic and inflammatory pathways in US health professionals. Am J Clin Nutr. 2019 Mar 1;109:635-47.

10. World Health Organization. Obesity and overweight. 2018 [cited 2019 2/4]; Available from: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>

11. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of Obesity Among Adults and Youth: United States, 2015–2016. NCHS Data Brief 2017 [cited 2019 Jan 29]; Available from: <https://www.cdc.gov/nchs/products/databriefs/db288.htm>

12. Smith L, Roberts J, Johnstone J, Yang L. Overweight and Obesity. Reference Module in Biomedical Sciences: Elsevier; 2018.

13. Tabrizi R, Saneei P, Lankarani KB, Akbari M, Kolahdooz F, Esmaillzadeh A, Nadi-Ravandi S, Mazoochi M, Asemi Z. The effects of caffeine intake on weight loss: a systematic review and dos-response meta-analysis of randomized controlled trials. Crit Rev Food Sci Nutr. 2019;59:2688-96.

14. Acheson KJ, Zahorska-Markiewicz B, Pittet P, Anantharaman K, Jequier E. Caffeine and coffee: their influence on metabolic rate and substrate utilization in normal weight and obese individuals. Am J Clin Nutr. 1980 May;33:989-97.

15. Wells JC, Fewtrell MS. Measuring body composition. Arch Dis Child. 2006 Jul;91:612-7.

16. Curtin LR, Mohadjer LK, Dohrmann SM, Montaquila JM, Kruszan-Moran D, Mirel LB, Carroll MD, Hirsch R, Schober S, Johnson CL. The National Health and Nutrition Examination Survey: Sample Design, 1999-2006. Vital and health statistics Series 2, Data evaluation and methods research. 2012 May:1-39.

17. Soysal P, Cao C, Xu T, Yang L, Isik AT, Turan Kazancioglu R, Liu Q, Pizzol D, Veronese N, Demurtas J, et al. Trends and prevalence of nocturia among US adults, 2005-2016. Int Urol Nephrol. 2019 Dec 19.

18. Statistics NCfH. NHANES 1999-2006 DXA Multiple Imputation Data Files. 2018 [cited 2020 2/4]; Available from: <https://wwwn.cdc.gov/nchs/nhanes/dxa/dxa.aspx>

19. Subar AF, Thompson FE, Kipnis V, Midthune D, Hurwitz P, McNutt S, McIntosh A, Rosenfeld S. Comparative validation of the Block, Willett, and National Cancer Institute food frequency questionnaires : the Eating at America's Table Study. Am J Epidemiol. 2001 Dec 15;154:1089-99.

20. National Health and Nutrition Examination Survey. 2005-2006 Data Documentation. 2010 [cited 2020 2/4]; Available from: <https://wwwn.cdc.gov/Nchs/Nhanes/2005-2006/FOODLK_D.htm>

21. Center for Disease Control. Technical Documentation for the 1999-2004 Dual Energy X-Ray Absorptiometry (DXA) Multiple Imputation Data files 2008.

22. Cao C, Yang L, Cade WT, Racette SB, Park Y, Cao Y, Friedenreich CM, Hamer M, Stamatakis E, Smith L. Cardiorespiratory Fitness Is Associated with Early Death Among Healthy Young and Middle-aged Baby Boomers and Generation Xers. The American Journal of Medicine.

23. Yang L, Cao C, Kantor ED, Nguyen LH, Zheng X, Park Y, Giovannucci EL, Matthews CE, Colditz GA, Cao Y. Trends in Sedentary Behavior Among the US Population, 2001-2016. JAMA. 2019 Apr 23;321:1587-97.

24. Roberts J, Liu Q, Cao C, Jackson SE, Zong X, Meyer GA, Yang L, Cade WT, Zheng X, Lopez-Sanchez GF, et al. Association of Hot Tea Consumption with Regional Adiposity Measured by Dual-Energy X-Ray Absorptiometry in NHANES 2003-2006. Obesity (Silver Spring). 2020 Feb;28:445-51.

25. Jaklitsch MT, Jacobson FL, Austin JHM, Field JK, Jett JR, Keshavjee S, MacMahon H, Mulshine JL, Munden RF, Salgia R, et al. The American Association for Thoracic Surgery guidelines for lung cancer screening using low-dose computed tomography scans for lung cancer survivors and other high-risk groups. J Thorac Cardiovasc Surg. 2012;144:33-8.

26. Grabovac I, Smith L, Stefanac S, Haider S, Cao C, Waldhoer T, Jackson SE, Yang L. Health Care Providers' Advice on Lifestyle Modification in the US Population: Results from the NHANES 2011-2016. Am J Med. 2019 Apr;132:489-97 e1.

27. Williams-Smith DL, Cammack R. Oxidation-reduction potentials of cytochromes P-450 and ferredoxin in the bovine adrenal. Their modification by substrates and inhibitors. Biochim Biophys Acta. 1977 Oct 25;499:432-42.

28. Geer EB, Shen W. Gender differences in insulin resistance, body composition, and energy balance. Gend Med. 2009;6 Suppl 1:60-75.

29. Hamilton MT, Hamilton DG, Zderic TW. Role of low energy expenditure and sitting in obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease. Diabetes. 2007 Nov;56:2655-67.

30. Lee A, Lim W, Kim S, Khil H, Cheon E, An S, Hong S, Lee DH, Kang SS, Oh H, et al. Coffee Intake and Obesity: A Meta-Analysis. Nutrients. 2019 Jun 5;11:1274.

31. Koot P, Deurenberg P. Comparison of changes in energy expenditure and body temperatures after caffeine consumption. Ann Nutr Metab. 1995;39:135-42.

32. Muhammad HFL, Sulistyoningrum DC, Huriyati E, Lee YY, Manan Wan Muda WA. The Interaction between Coffee: Caffeine Consumption, UCP2 Gene Variation, and Adiposity in Adults-A Cross-Sectional Study. J Nutr Metab. 2019;2019:9606054.

33. Murase T, Misawa K, Minegishi Y, Aoki M, Ominami H, Suzuki Y, Shibuya Y, Hase T. Coffee polyphenols suppress diet-induced body fat accumulation by downregulating SREBP-1c and related molecules in C57BL/6J mice. Am J Physiol Endocrinol Metab. 2011 Jan;300:E122-33.

34. Vidal-Puig A, Rosenbaum M, Considine RC, Leibel RL, Dohm GL, Lowell BB. Effects of obesity and stable weight reduction on UCP2 and UCP3 gene expression in humans. Obes Res. 1999 Mar;7:133-40.

35. Kim JH, Park YS, Kim H. Association between metabolic syndrome and coffee consumption in the Korean population by gender: a cross-sectional study in Korea. Asia Pacific journal of clinical nutrition. 2018;27:1131-40.

36. Grosso G, Stepaniak U, Micek A, Topor-Madry R, Pikhart H, Szafraniec K, Pajak A. Association of daily coffee and tea consumption and metabolic syndrome: results from the Polish arm of the HAPIEE study. European journal of nutrition. 2015 Oct;54:1129-37.

37. Temple JL, Ziegler AM. Gender Differences in Subjective and Physiological Responses to Caffeine and the Role of Steroid Hormones. Journal of caffeine research. 2011 Mar;1:41-8.

38. Mayes JS, Watson GH. Direct effects of sex steroid hormones on adipose tissues and obesity. Obes Rev. 2004 Nov;5:197-216.

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| **Table 1. Characteristics of the US Adults 20-69 Years from the NHANES 2003-2006, According to Daily Coffee Consumption1,2** | | | | | | | | | | | | | |
| **Characteristic** | Men (N=2,749) | | | | | |  | Women (N=2,947) | | | | | |
|  | No Coffee | 0-<0.25 cup/day | 0.25-<1 cup/day | 1 cup/day | 2-3 cups/day | ≥4 cups/day |  | No Coffee | 0-<0.25 cup/day | 0.25-<1 cup/day | 1 cup/day | 2-3 cups/day | ≥4 cups/day |
|  | (N=668) | (N=398) | (N=332) | (N=422) | (N=688) | (N=241) |  | (N=781) | (N=479) | (N=347) | (N=539) | (N=640) | (N=161) |
| Age, y | 40.3 (0.7) | 38.8 (0.7) | 45.2 (0.8) | 48.8 (0.9) | 51.2 (0.6) | 51.2 (0.7) |  | 42.2 (0.6) | 41.7 (0.9) | 44.1 (0.6) | 51.6 (1.0) | 51.5 (0.6) | 50.4 (0.9) |
| Race/ethnicity, % |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Non-Hispanic White | 24.1 | 11.4 | 8.8 | 11.6 | 31.6 | 12.5 |  | 26.9 | 12.2 | 9.7 | 14.1 | 28.5 | 8.6 |
| Non-Hispanic Black | 39.6 | 20.1 | 15.8 | 10.1 | 13.0 | 1.6 |  | 39.1 | 23.9 | 14.4 | 11.9 | 9.7 | 1.2 |
| Hispanic | 23.3 | 20.7 | 18.1 | 18.9 | 16.6 | 2.5 |  | 21.1 | 21.7 | 14.2 | 25.1 | 16.0 | 1.9 |
| Other | 21.5 | 19.8 | 13.1 | 23.1 | 12.0 | 10.6 |  | 22.1 | 16.1 | 15.2 | 19.1 | 20.7 | 6.8 |
| Annual Household Income, % | |  |  |  |  |  |  |  |  |  |  |  |  |
| <$25,000 | 26.5 | 14.0 | 10.0 | 13.3 | 24.9 | 11.2 |  | 31.3 | 14.8 | 9.2 | 15.6 | 21.8 | 7.3 |
| $25,000-74,999 | 24.3 | 14.9 | 12.4 | 13.0 | 25.7 | 9.9 |  | 26.1 | 15.7 | 10.7 | 14.9 | 25.3 | 7.3 |
| ≥$75,000 | 25.6 | 11.4 | 8.3 | 12.7 | 31.2 | 10.7 |  | 26.6 | 12.4 | 13.1 | 15.4 | 26.4 | 6.2 |
| Educational attainment, % | |  |  |  |  |  |  |  |  |  |  |  |  |
| <High School | 26.9 | 13.4 | 12.9 | 15.2 | 22.5 | 9.1 |  | 22.7 | 17.0 | 10.3 | 20.1 | 21.7 | 8.1 |
| High School | 23.8 | 12.0 | 11.3 | 12.5 | 28.1 | 12.3 |  | 29.2 | 12.7 | 10.0 | 15.3 | 26.6 | 6.1 |
| >High school | 25.5 | 14.4 | 9.6 | 12.4 | 28.3 | 9.9 |  | 27.7 | 15.0 | 11.6 | 14.1 | 24.6 | 7.1 |
| Smoking status, % |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Never | 34.8 | 17.1 | 10.7 | 11.4 | 20.0 | 6.0 |  | 33.1 | 17.9 | 12.0 | 16.3 | 18.2 | 2.6 |
| Past | 15.8 | 9.7 | 9.9 | 16.1 | 37.5 | 11.0 |  | 18.5 | 10.7 | 10.0 | 19.0 | 33.9 | 7.9 |
| Current | 20.3 | 12.2 | 11.1 | 11.8 | 28.1 | 16.5 |  | 21.3 | 10.2 | 9.4 | 8.8 | 32.7 | 17.7 |
| Diabetes, % |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Yes | 22.0 | 9.3 | 11.9 | 11.7 | 36.0 | 9.2 |  | 27.2 | 11.9 | 14.1 | 17.1 | 23.3 | 6.4 |
| Physically active,3 % | 26.0 | 13.9 | 10.1 | 12.8 | 27.3 | 9.9 |  | 28.3 | 14.5 | 11.9 | 14.2 | 24.8 | 6.4 |
| Television Viewing, hours/day | 2.3 (0.08) | 2.3 (0.10) | 2.6 (0.12) | 2.2 (0.09) | 2.4 (0.06) | 2.6 (0.08) |  | 2.4 (0.07) | 2.3 (0.09) | 2.1 (0.09) | 2.2 (0.09) | 2.3 (0.07) | 2.3 (0.13) |
| Computer Use, hours/day | 0.8 (0.05) | 0.9 (0.09) | 0.7 (0.07) | 0.8 (0.07) | 0.8 (0.06) | 0.8 (0.09) |  | 0.8 (0.03) | 0.9 (0.06) | 0.8 (0.07) | 0.5 (0.03) | 0.8 (0.04) | 0.8 (0.08) |
| Healthy Eating Index-2010 | 46.8 (0.8) | 49.7 (1.0) | 50.0 (0.8) | 50.3 (0.8) | 50.6 (0.7) | 48.2 (1.1) |  | 50.1 (0.7) | 51.9 (0.8) | 52.1 (1.1) | 53.7 (0.5) | 53.8 (1.0) | 47.6 (1.3) |
| 1 All estimates were weighted to be nationally representative. Values are means ± SEs or %.  2 One cup approximately equals to 236.59 mL in the US.  3 Physically active was defined as engaging in moderate or vigorous recreational physical activity over the past 30 days | | | | | | | | | | | | | |

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| **Table 2. Association of Coffee Consumption and Body Fat Percentage Among Men by Age Group, NHANES 2003-20061** | | | | | | | | |
|  | **β-Coefficient (95% CI)** | | | | | | | |
|  | **All age** | |  | **20-44 years (N=1157)** | |  | **45-69 years (N=1592)** | |
|  | **Age-adjusted** | **MV-adjusted2** |  | **Age-adjusted** | **MV-adjusted2** |  | **Age-adjusted** | **MV-adjusted2** |
| **Total body fat %** |  |  |  |  |  |  |  |  |
| No Coffee | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |
| 0-<0.25 cup/day | -0.9 (-1.6 to -0.1) | -0.5 (-1.3 to 0.3) |  | -1.4 (-2.6 to -0.3) | -1.3 (-2.2 to -0.4) |  | 0.5 (-1.2 to 2.1) | 1.3 (-0.3 to 2.9) |
| 0.25-<1 cup/day | -0.7 (-1.6 to 0.2) | -0.2 (-1.1 to 0.6) |  | -1.1 (-2.4 to 0.2) | -0.8 (-1.9 to 0.3) |  | 0 (-1.4 to 1.4) | 0.5 (-0.8 to 1.8) |
| 1 cup/day | 0 (-0.9 to 0.8) | 0.4 (-0.5 to 1.3) |  | 0.0 (-1.2 to 1.2) | 0.1 (-1.1 to 1.3) |  | 0.3 (-0.8 to 1.5) | 0.7 (-0.4 to 1.9) |
| 2-3 cups/day | -0.4 (-1.2 to 0.4) | 0 (-0.9 to 0.8) |  | -1.7 (-2.8 to -0.6) | -1.3 (-2.7 to 0.1) |  | 0.7 (-0.7 to 2.1) | 0.8 (-0.5 to 2.2) |
| ≥4 cups/day | -0.5 (-1.6 to 0.7) | 0.1 (-1.2 to 1.5) |  | 0.2 (-1.2 to 1.6) | 0.4 (-1.5 to 2.3) |  | -0.4 (-1.9 to 1.2) | 0.1 (-1.6 to 1.8) |
| *P* for trend3 | 0.58 | 0.68 |  | 0.98 | 0.59 |  | 0.85 | 0.65 |
| **Trunk body fat %** |  |  |  |  |  |  |  |  |
| No Coffee | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |
| 0-<0.25 cup/day | -1 (-1.9 to -0.1) | -0.6 (-1.5 to 0.3) |  | -1.7 (-3.0 to -0.4) | -1.6 (-2.6 to -0.6) |  | 0.6 (-1.2 to 2.5) | 1.7 (-0.2 to 3.6) |
| 0.25-<1 cup/day | -0.6 (-1.7 to 0.4) | -0.1 (-1.0 to 0.8) |  | -1.2 (-2.8 to 0.4) | -1.1 (-2.4 to 0.2) |  | 0.4 (-1.0 to 1.9) | 1.1 (-0.4 to 2.6) |
| 1 cup/day | 0.1 (-1.0 to 1.1) | 0.5 (-0.5 to 1.5) |  | 0.1 (-1.4 to 1.5) | 0 (-1.4 to 1.3) |  | 0.5 (-0.8 to 1.7) | 1.0 (-0.4 to 2.5) |
| 2-3 cups/day | -0.5 (-1.5 to 0.5) | -0.1 (-1.1 to 0.9) |  | -2.1 (-3.4 to -0.8) | -1.8 (-3.3 to -0.4) |  | 0.9 (-0.6 to 2.4) | 1.1 (-0.5 to 2.7) |
| ≥4 cups/day | -0.7 (-2.1 to 0.7) | 0.1 (-1.5 to 1.6) |  | -0.1 (-1.8 to 1.6) | -0.2 (-2.3 to 2) |  | -0.4 (-2.3 to 1.5) | 0.3 (-1.8 to 2.3) |
| *P* for trend3 | 0.48 | 0.74 |  | 0.59 | 0.24 |  | 0.52 | 0.58 |
| 1 Coffee consumption measured in cup/day; one cup approximately equals to 236.59 mL in the US.  2 All multivariable-adjusted (MV-adjusted) models wereadjusted for age (continuous), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian, others), household income (<$25,000, $25,000 to $74,999, and ≥ $75,000), physically active (yes/no), television view daily hours (continuous), computer use daily hours (continuous), educational attainment (< high school, high school, and > high school), smoking status (never smoking, past < 20 pack-years, past ≥20 pack-years, past without pack-year information, current < 20 pack-years, and current ≥ 20 pack-years), comorbidity (hypertension, high blood cholesterol, coronary heart diseases, osteoarthritis, stroke, and diabetes), frequency of coffee added sugar/creamer/milk use, consumption of soda beverage (continuous), consumption of alcohol intake (wine, beer, and liquor), consumption of hot/ice tea (continuous), total energy intake(continuous), the Alternate Healthy Eating Index 2010(continuous) and intention to lose/control weight (yes/no).  3 *P* for trend was calculated using the daily coffee consumption as a continuous variable (cups/day). | | | | | | | | |

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| **Table 3. Association of Coffee Consumption and Body Fat Percentage Among Women by Age Group, NHANES 2003-20061** | | | | | | | | |
|  | **β-Coefficient (95% CI)** | | | | | | | |
|  | **All age** | |  | **20-44 years (N=1249)** | |  | **45-69 years (N=1698)** | |
|  | **Age-adjusted** | **MV-adjusted2** |  | **Age-adjusted** | **MV-adjusted2** |  | **Age-adjusted** | **MV-adjusted2** |
| **Total body fat Percentage** | | |  |  |  |  |  |  |
| No Coffee | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |
| 0-<0.25 cup/day | -0.8 (-1.9 to 0.2) | -0.7 (-1.8 to 0.4) |  | -0.4 (-1.5 to 0.7) | 0.2 (-1.0 to 1.5) |  | -1.4 (-3.0 to 0.2) | -2.3 (-4.0 to -0.5) |
| 0.25-<1 cup/day | -1.2 (-2.1 to -0.2) | -0.9 (-1.9 to 0) |  | -1.4 (-2.6 to -0.3) | -0.5 (-1.8 to 0.8) |  | -0.7 (-2.3 to 0.9) | -1.2 (-3.0 to 0.5) |
| 1 cup/day | -1.4 (-2.3 to -0.4) | -1.0 (-2.0 to -0.1) |  | -1.9 (-3.0 to -0.7) | -1.0 (-2.4 to 0.4) |  | -0.8 (-1.8 to 0.3) | -1.0 (-2.3 to 0.3) |
| 2-3 cups/day | -2.3 (-3.0 to -1.6) | -1.9 (-2.7 to -1.0) |  | -2.8 (-4.0 to -1.5) | -2.1 (-3.6 to -0.5) |  | -1.7 (-2.7 to -0.7) | -1.8 (-2.9 to -0.8) |
| ≥4 cups/day | -2.3 (-3.5 to -1.1) | -2.0 (-3.2 to -0.7) |  | -1.4 (-3.5 to 0.7) | -1.0 (-3.5 to 1.4) |  | -2.8 (-4.3 to -1.4) | -2.5 (-4.5 to -0.6) |
| *P* for trend3 | <0.001 | <0.001 |  | 0.002 | 0.025 |  | <0.001 | 0.012 |
| **Trunk body fat Percentage** | | |  |  |  |  |  |  |
| No Coffee | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |
| 0-<0.25 cup/day | -1.0 (-2.4 to 0.3) | -0.8 (-2.2 to 0.5) |  | -0.7 (-2.2 to 0.8) | 0.2 (-1.4 to 1.7) |  | -1.3 (-3.5 to 0.8) | -2.3 (-4.2 to -0.3) |
| 0.25-<1 cup/day | -1.5 (-2.6 to -0.3) | -1.4 (-2.5 to -0.3) |  | -2.1 (-3.4 to -0.7) | -1.2 (-2.6 to 0.3) |  | -0.5 (-2.3 to 1.2) | -1.3 (-3.4 to 0.8) |
| 1 cup/day | -1.4 (-2.6 to -0.3) | -1.3 (-2.4 to -0.1) |  | -2.2 (-3.6 to -0.8) | -1.4 (-3.0 to 0.3) |  | -0.6 (-1.8 to 0.6) | -0.9 (-2.5 to 0.7) |
| 2-3 cups/day | -2.8 (-3.8 to -1.8) | -2.6 (-3.7 to -1.5) |  | -3.4 (-5.1 to -1.6) | -2.9 (-4.9 to -0.9) |  | -2.1 (-3.4 to -0.8) | -2.5 (-3.9 to -1.1) |
| ≥4 cups/day | -3.4 (-4.8 to -1.9) | -3.4 (-4.9 to -2.0) |  | -2.2 (-5.0 to 0.6) | -2.2 (-5.2 to 0.7) |  | -4.1 (-5.9 to -2.3) | -4.3 (-6.7 to -2.0) |
| *P* for trend3 | <0.001 | <0.001 |  | 0.003 | 0.007 |  | <0.001 | 0.002 |
| 1 Coffee consumption measured in cup/day; one cup approximately equals to 236.59 mL in the US.  2 All multivariable-adjusted (MV-adjusted) models wereadjusted for age (continuous), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian, others), household income (<$25,000, $25,000 to $74,999, and ≥ $75,000), physically active (yes/no), television view daily hours (continuous), computer use daily hours (continuous), educational attainment (< high school, high school, and > high school), smoking status (never smoking, past < 20 pack-years, past ≥20 pack-years, past without pack-year information, current < 20 pack-years, and current ≥ 20 pack-years), menopause status (yes/no), comorbidity (hypertension, high blood cholesterol, coronary heart diseases, osteoarthritis, stroke, and diabetes), frequency of coffee added sugar/creamer/milk use, consumption of soda beverage (continuous), consumption of alcohol intake (wine, beer, and liquor), consumption of hot/ice tea (continuous), total energy intake(continuous), the Healthy Eating Index 2010(continuous) and intention to lose/control weight (yes/no).  3 *P* for trend was calculated using the daily coffee consumption as a continuous variable (cups/day). | | | | | | | | |

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| **Table 4. Multivariable-adjusted Association of Coffee Consumption and Body Fat Percentage Among Women by Race/Ethnicity, NHANES 2003-20061,2** | | | | | | | | |
|  | **β-Coefficient (95% CI)** | | | | | | | |
|  | **Non-Hispanic White (N=1263)** | |  | **Non-Hispanic Black (N=593)** | |  | **Hispanic (N=585)** | |
|  | **Age-adjusted** | **MV-adjusted1** |  | **Age-adjusted** | **MV-adjusted1** |  | **Age-adjusted** | **MV-adjusted1** |
| **Total body fat %** |  |  |  |  |  |  |  |  |
| No Coffee | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |
| 0-<0.25 cup/day | -1.6 (-3.3 to 0.2) | -1.1 (-2.7 to 0.5) |  | -0.6 (-2 to 0.8) | -1 (-2.7 to 0.8) |  | 0.1 (-1.5 to 1.7) | -0.5 (-2.3 to 1.3) |
| 0.25-<1 cup/day | -1.1 (-2.5 to 0.4) | -0.5 (-1.9 to 0.9) |  | -0.9 (-2 to 0.2) | -1.4 (-3.2 to 0.3) |  | -1.7 (-3.8 to 0.4) | -2.3 (-4.1 to -0.5) |
| 1 cup/day | -1.4 (-2.6 to -0.2) | -1 (-2.2 to 0.3) |  | -1 (-2.6 to 0.7) | -1.1 (-2.6 to 0.5) |  | -0.5 (-2.7 to 1.6) | -1.1 (-3.1 to 0.8) |
| 2-3 cups/day | -2.2 (-3.1 to -1.3) | -1.7 (-2.8 to -0.6) |  | -0.9 (-2.7 to 1) | -1.8 (-4.6 to 0.9) |  | -2.7 (-4.9 to -0.5) | -3.5 (-6.2 to -0.8) |
| ≥4 cups/day | -2.2 (-3.6 to -0.7) | -2.0 (-3.5 to -0.5) |  | 0.5 (-4.7 to 5.7) | -1.8 (-6.6 to 3.1) |  | -0.6 (-3.4 to 2.3) | -3.2 (-7.2 to 0.8) |
| *P* for trend3 | <0.001 | <0.001 |  | 0.27 | 0.10 |  | 0.048 | 0.019 |
| **Trunk body fat %** |  |  |  |  |  |  |  |  |
| No Coffee | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |
| 0-<0.25 cup/day | -1.8 (-3.9 to 0.3) | -1.0 (-2.8 to 0.9) |  | -0.9 (-2.6 to 0.9) | -0.9 (-3.1 to 1.2) |  | -0.6 (-2.5 to 1.2) | -1.2 (-3.3 to 0.9) |
| 0.25-<1 cup/day | -1.5 (-3.2 to 0.2) | -0.9 (-2.4 to 0.6) |  | -1 (-2.3 to 0.4) | -1.5 (-3.6 to 0.5) |  | -2.8 (-5.2 to -0.4) | -3.7 (-6.0 to -1.4) |
| 1 cup/day | -1.4 (-2.9 to 0.1) | -1.1 (-2.6 to 0.5) |  | -1.1 (-3.5 to 1.3) | -0.9 (-3.0 to 1.1) |  | -1.4 (-4.2 to 1.5) | -2.1 (-4.6 to 0.3) |
| 2-3 cups/day | -2.5 (-3.8 to -1.3) | -2.4 (-3.9 to -0.8) |  | -1.5 (-3.8 to 0.8) | -2.6 (-5.9 to 0.7) |  | -3.6 (-6.3 to -0.9) | -4.9 (-8.3 to -1.6) |
| ≥4 cups/day | -3.0 (-4.7 to -1.3) | -3.5 (-5.3 to -1.8) |  | 0.3 (-6.3 to 6.7) | -2.6 (-7.7 to 2.6) |  | -1.9 (-5.8 to 1.9) | -5.0 (-9.5 to -0.5) |
| *P* for trend3 | <0.001 | 0.002 |  | 0.21 | 0.09 |  | 0.026 | 0.007 |
| 1 All multivariable-adjusted (MV-adjusted) models wereadjusted for age (continuous), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian, others), household income (<$25,000, $25,000 to $74,999, and ≥ $75,000), physically active (yes/no), television view daily hours (continuous), computer use daily hours (continuous), educational attainment (< high school, high school, and > high school), smoking status (never smoking, past < 20 pack-years, past ≥20 pack-years, past without pack-year information, current < 20 pack-years, and current ≥ 20 pack-years), menopause status (yes/no), comorbidity (hypertension, high blood cholesterol, coronary heart diseases, osteoarthritis, stroke, and diabetes), frequency of coffee added sugar/creamer/milk use, consumption of soda beverage (continuous), consumption of alcohol intake (wine, beer, and liquor), consumption of hot/ice tea (continuous), total energy intake(continuous), the Healthy Eating Index 2010(continuous) and intention to lose/control weight (yes/no).  2 Coffee consumption measured in cup/day; one cup approximately equals to 236.59 mL in the US.  3 *P* for trend was calculated using the daily coffee consumption as a continuous variable (cups/day). | | | | | | | | |

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| **Supplemental Table 1. Multivariable-adjusted Linear Regression Models of Total and Trunk Body Fat Percentage Among Men Aged 20-69 Years, NHANES 2003-2006** | | | | | | | |
|  | **β-Coefficient (95% CI)** | |  |  |  |  |  |
|  | **Total body fat %** | | |  | **Trunk body fat %** | | |
|  | **All** | **20-44 years** | **45-69 years** |  | **All** | **20-44 years** | **45-69 years** |
| Coffee Consumption1 |  |  |  |  |  |  |  |
| No Coffee | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| 0-<0.25 cup/day | -0.5 (-1.3 to 0.3) | -1.3 (-2.2 to -0.4) | 1.3 (-0.3 to 2.9) |  | -0.6 (-1.5 to 0.3) | -1.6 (-2.6 to -0.6) | 1.7 (-0.2 to 3.6) |
| 0.25-<1 cup/day | -0.2 (-1.1 to 0.6) | -0.8 (-1.9 to 0.3) | 0.5 (-0.8 to 1.8) |  | -0.1 (-1 to 0.8) | -1.1 (-2.4 to 0.2) | 1.1 (-0.4 to 2.6) |
| 1 cup/day | 0.4 (-0.5 to 1.3) | 0.1 (-1.1 to 1.3) | 0.7 (-0.4 to 1.9) |  | 0.5 (-0.5 to 1.5) | 0 (-1.4 to 1.3) | 1 (-0.4 to 2.5) |
| 2-3 cups/day | 0 (-0.9 to 0.8) | -1.3 (-2.7 to 0.1) | 0.8 (-0.5 to 2.2) |  | -0.1 (-1.1 to 0.9) | -1.8 (-3.3 to -0.4) | 1.1 (-0.5 to 2.7) |
| ≥4 cups/day | 0.1 (-1.2 to 1.5) | 0.4 (-1.5 to 2.3) | 0.1 (-1.6 to 1.8) |  | 0.1 (-1.5 to 1.6) | -0.2 (-2.3 to 2) | 0.3 (-1.8 to 2.3) |
| Age, year2 | 0.1 (0 to 0.1) | 0.1 (0.1 to 0.2) | 0 (0 to 0.1) |  | 0.1 (0.1 to 0.2) | 0.2 (0.1 to 0.3) | 0 (0 to 0.1) |
| Race/ethnicity |  |  |  |  |  |  |  |
| Non-Hispanic white | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Non-Hispanic black | -1.3 (-1.9 to -0.8) | -0.8 (-1.8 to 0.2) | -2.3 (-3.6 to -0.9) |  | -1.8 (-2.5 to -1.2) | -1.3 (-2.4 to -0.1) | -3 (-4.6 to -1.4) |
| Hispanic | 0.7 (-0.1 to 1.5) | 1.1 (0 to 2.3) | -0.6 (-1.9 to 0.8) |  | 1.6 (0.6 to 2.6) | 2.1 (0.8 to 3.4) | 0 (-1.5 to 1.6) |
| Other | 0.3 (-0.8 to 1.5) | 0.2 (-1.4 to 1.9) | 0.6 (-0.8 to 2) |  | 0.9 (-0.5 to 2.2) | 0.9 (-1.2 to 2.9) | 1 (-0.6 to 2.6) |
| Household income |  |  |  |  |  |  |  |
| <$25,000 | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| $25,000-<$75,000 | 0.9 (0.5 to 1.4) | 1.3 (0.5 to 2.1) | 0.3 (-0.5 to 1.2) |  | 1.2 (0.7 to 1.8) | 1.8 (0.8 to 2.8) | 0.3 (-0.8 to 1.3) |
| ≥$75,000 | 0.9 (0.3 to 1.6) | 0.9 (0.1 to 1.8) | 0.4 (-0.7 to 1.6) |  | 1.5 (0.7 to 2.4) | 1.6 (0.6 to 2.6) | 0.6 (-0.8 to 2) |
| Education |  |  |  |  |  |  |  |
| <High school | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| High school | 0.8 (-0.1 to 1.8) | 0.5 (-0.5 to 1.6) | 0.9 (-0.4 to 2.2) |  | 1.1 (-0.1 to 2.2) | 0.6 (-0.6 to 1.8) | 1.1 (-0.5 to 2.6) |
| >High school | -0.2 (-1.2 to 0.8) | -0.3 (-1.6 to 1) | 0 (-1.4 to 1.4) |  | -0.3 (-1.5 to 0.9) | -0.4 (-1.9 to 1.1) | -0.2 (-1.9 to 1.4) |
| Physically Active3 |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | -1.2 (-1.8 to -0.5) | -1.5 (-2.3 to -0.7) | -0.7 (-1.5 to 0.1) |  | -1.3 (-2 to -0.6) | -1.6 (-2.5 to -0.7) | -0.8 (-1.6 to 0.1) |
| Television Viewing, hours/day2 | 0.3 (0.1 to 0.5) | 0.4 (0.1 to 0.7) | 0.3 (0 to 0.5) |  | 0.3 (0.2 to 0.5) | 0.5 (0.1 to 0.8) | 0.3 (0 to 0.6) |
| Computer Use, hours/day2 | 0.3 (0.1 to 0.5) | 0.2 (0 to 0.5) | 0.5 (0.2 to 0.8) |  | 0.3 (0 to 0.6) | 0.2 (-0.1 to 0.5) | 0.6 (0.2 to 0.9) |
| Smoke status |  |  |  |  |  |  |  |
| Never smoking | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Past |  |  |  |  |  |  |  |
| < 20 pack-years | -0.8 (-1.7 to 0.1) | -0.1 (-1.2 to 1.1) | -1.2 (-2.2 to -0.2) |  | -0.8 (-1.9 to 0.2) | -0.2 (-1.5 to 1.1) | -1.2 (-2.3 to 0) |
| ≥ 20 pack-years | 0.3 (-0.6 to 1.2) | 2.5 (-0.6 to 5.6) | 0 (-0.7 to 0.7) |  | 0.1 (-0.9 to 1.1) | 2.2 (-0.4 to 4.8) | 0.1 (-0.9 to 1) |
| without pack-year information | 0.9 (-0.6 to 2.5) | 2 (0.2 to 3.8) | -0.8 (-2.6 to 1) |  | 0.9 (-1 to 2.8) | 2 (-0.1 to 4.1) | -0.7 (-2.6 to 1.3) |
| Current |  |  |  |  |  |  |  |
| < 20 pack-years | -1.6 (-2.3 to -0.8) | -1.3 (-2.4 to -0.2) | -1.7 (-3.5 to 0.2) |  | -2 (-3 to -1.1) | -1.5 (-2.9 to -0.2) | -2.2 (-4.2 to -0.2) |
| ≥ 20 pack-years | -1.8 (-3 to -0.5) | -2.7 (-4.8 to -0.7) | -1.6 (-2.8 to -0.3) |  | -2.2 (-3.6 to -0.8) | -3.2 (-5.4 to -0.9) | -2 (-3.4 to -0.6) |
| Hypertension |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 1.6 (1.1 to 2.1) | 2.6 (1.7 to 3.4) | 1.1 (0.4 to 1.7) |  | 2.3 (1.7 to 2.8) | 3.2 (2.2 to 4.2) | 1.7 (0.8 to 2.6) |
| High cholesterol |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 0.7 (0.1 to 1.2) | 0.5 (-0.2 to 1.3) | 0.7 (0 to 1.5) |  | 1.1 (0.5 to 1.7) | 0.9 (-0.1 to 2) | 1.1 (0.3 to 2) |
| Heart disease |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 0.5 (-0.7 to 1.6) | -1.1 (-4.3 to 2.2) | 0.8 (-0.3 to 1.9) |  | 0.4 (-0.9 to 1.6) | -1.8 (-5.4 to 1.8) | 0.9 (-0.3 to 2.2) |
| Osteoarthritis |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 0.9 (-0.1 to 1.8) | 1.3 (-0.4 to 3) | 0.8 (-0.2 to 1.8) |  | 0.9 (-0.1 to 1.9) | 1.3 (-0.7 to 3.3) | 0.9 (-0.2 to 1.9) |
| Stroke |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | -0.1 (-1.9 to 1.7) | -2.8 (-8.8 to 3.2) | 0.6 (-1.4 to 2.5) |  | -0.1 (-2.3 to 2.1) | -2 (-10.1 to 6.2) | 0.5 (-1.6 to 2.7) |
| Diabetes |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 1.1 (0 to 2.3) | 1.4 (-0.3 to 3.1) | 1.2 (-0.1 to 2.5) |  | 1.6 (0.4 to 2.8) | 1.9 (-0.1 to 3.9) | 1.8 (0.4 to 3.2) |
| Cancer |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | -0.6 (-1.7 to 0.4) | -0.3 (-3.8 to 3.1) | -0.8 (-1.9 to 0.4) |  | -1.2 (-2.5 to 0) | -2.1 (-6.1 to 1.9) | -1.1 (-2.5 to 0.3) |
| Total energy intake, per 100 kcal/day2 | -0.6 (-0.8 to -0.3) | -0.5 (-0.9 to -0.1) | -0.8 (-1.2 to -0.4) |  | -0.6 (-0.9 to -0.3) | -0.6 (-1 to -0.2) | -0.9 (-1.4 to -0.4) |
| Sugar in coffee2 | -0.4 (-0.6 to -0.2) | -0.5 (-1 to 0) | -0.4 (-0.7 to -0.1) |  | -0.4 (-0.7 to -0.2) | -0.5 (-1 to 0) | -0.5 (-0.9 to 0) |
| Sweeten in coffee2 | 0.1 (-0.3 to 0.4) | -0.4 (-1 to 0.2) | 0.4 (0 to 0.7) |  | 0.1 (-0.3 to 0.4) | -0.3 (-1.1 to 0.4) | 0.4 (0 to 0.8) |
| Creamer in coffee2 | 0.1 (-0.1 to 0.4) | 0.2 (-0.3 to 0.8) | 0.1 (-0.2 to 0.4) |  | 0.2 (-0.1 to 0.5) | 0.4 (-0.2 to 1.1) | 0.1 (-0.2 to 0.5) |
| Half and half in coffee2 | 0.2 (-0.2 to 0.7) | 0.8 (-0.1 to 1.7) | 0 (-0.4 to 0.3) |  | 0.2 (-0.2 to 0.7) | 0.9 (0.1 to 1.7) | -0.1 (-0.5 to 0.3) |
| Milk in coffee2 | -0.2 (-0.6 to 0.2) | -0.2 (-0.7 to 0.2) | -0.1 (-0.5 to 0.3) |  | -0.2 (-0.7 to 0.2) | -0.4 (-0.9 to 0.2) | -0.1 (-0.6 to 0.4) |
| Soda during summer2 | 0.3 (-0.1 to 0.7) | 0.6 (0 to 1.1) | 0.1 (-0.3 to 0.5) |  | 0.5 (0 to 0.9) | 0.7 (0.1 to 1.3) | 0.1 (-0.3 to 0.6) |
| Soda during other seasons2 | -0.1 (-0.5 to 0.4) | -0.3 (-0.9 to 0.3) | 0.1 (-0.4 to 0.6) |  | -0.1 (-0.7 to 0.4) | -0.4 (-1 to 0.3) | 0.1 (-0.5 to 0.7) |
| Beer during summer2 | -0.4 (-0.7 to 0) | -0.1 (-0.7 to 0.6) | -0.6 (-1.3 to 0) |  | -0.4 (-0.8 to 0) | -0.2 (-1 to 0.7) | -0.6 (-1.3 to 0.1) |
| Beer during other seasons2 | -0.1 (-0.5 to 0.4) | -0.4 (-1.1 to 0.3) | 0.4 (-0.3 to 1) |  | 0 (-0.4 to 0.4) | -0.3 (-1.2 to 0.5) | 0.3 (-0.4 to 1.1) |
| Wine during summer2 | -0.1 (-1.1 to 1) | 0.2 (-1 to 1.4) | -0.2 (-2.2 to 1.9) |  | -0.2 (-1.3 to 0.9) | 0.1 (-1.3 to 1.5) | -0.5 (-2.7 to 1.6) |
| Liquor2 | 0 (-0.6 to 0.6) | -0.2 (-0.8 to 0.4) | 0.4 (-1 to 1.8) |  | 0 (-0.8 to 0.8) | -0.1 (-0.9 to 0.7) | 0.3 (-1.2 to 1.9) |
| Hot tea2 | -0.4 (-0.8 to 0.1) | 0.2 (-0.7 to 1.2) | -0.8 (-1.3 to -0.3) |  | -0.5 (-1 to 0.1) | 0.2 (-1 to 1.3) | -0.9 (-1.5 to -0.3) |
| Ice tea2 | 0.6 (0.3 to 0.9) | 1 (0.5 to 1.5) | 0.3 (-0.1 to 0.7) |  | 0.7 (0.3 to 1.1) | 1.1 (0.5 to 1.7) | 0.3 (-0.2 to 0.8) |
| Healthy Eating Index-20102 | 0 (-0.1 to 0) | -0.1 (-0.1 to 0) | 0 (-0.1 to 0) |  | -0.1 (-0.1 to 0) | -0.1 (-0.1 to 0) | 0 (-0.1 to 0) |
| Intention to lose weight |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 2.4 (1.7 to 3) | 3.2 (2 to 4.5) | 1.4 (0.6 to 2.2) |  | 3 (2.3 to 3.7) | 4.2 (2.7 to 5.6) | 1.8 (0.9 to 2.7) |
| Intention to control weight |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 1 (0.4 to 1.5) | 1.1 (0.4 to 1.8) | 0.8 (0 to 1.5) |  | 1.2 (0.6 to 1.9) | 1.2 (0.2 to 2.1) | 1.1 (0.1 to 2.1) |
| 1 Coffee consumption measured in cup/day; one cup approximately equals to 236.59 mL in the US.  2 Continuous variables in the model.  3 Physically active was defined as engaging in moderate or vigorous recreational physical activity over the past 30 days | | | | | | | |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Supplemental Table 2. Multivariable-adjusted Linear Regression Models of Total and Trunk Body Fat Percentage Among Women Aged 20-69 Years, NHANES 2003-2006** | | | | | | | |
|  | **β-Coefficient (95% CI)** | |  |  |  |  |  |
|  | **Total body fat %** |  |  |  | **Trunk body fat %** | | |
|  | **All** | **20-44 years** | **45-69 years** |  | **All** | **20-44 years** | **45-69 years** |
| Coffee Consumption1 |  |  |  |  |  |  |  |
| No Coffee | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| 0-<0.25 cup/day | -0.7 (-1.8 to 0.4) | 0.2 (-1 to 1.5) | -2.3 (-4 to -0.5) |  | -0.8 (-2.2 to 0.5) | 0.2 (-1.4 to 1.7) | -2.3 (-4.2 to -0.3) |
| 0.25-<1 cup/day | -0.9 (-1.9 to 0) | -0.5 (-1.8 to 0.8) | -1.2 (-3 to 0.5) |  | -1.4 (-2.5 to -0.3) | -1.2 (-2.6 to 0.3) | -1.3 (-3.4 to 0.8) |
| 1 cup/day | -1 (-2 to -0.1) | -1 (-2.4 to 0.4) | -1 (-2.3 to 0.3) |  | -1.3 (-2.4 to -0.1) | -1.4 (-3 to 0.3) | -0.9 (-2.5 to 0.7) |
| 2-3 cups/day | -1.9 (-2.7 to -1) | -2.1 (-3.6 to -0.5) | -1.8 (-2.9 to -0.8) |  | -2.6 (-3.7 to -1.5) | -2.9 (-4.9 to -0.9) | -2.5 (-3.9 to -1.1) |
| ≥4 cups/day | -2 (-3.2 to -0.7) | -1 (-3.5 to 1.4) | -2.5 (-4.5 to -0.6) |  | -3.4 (-4.9 to -2) | -2.2 (-5.2 to 0.7) | -4.3 (-6.7 to -2) |
| Age, year2 | 0.1 (0 to 0.1) | 0.1 (0.1 to 0.2) | 0 (-0.1 to 0.1) |  | 0.1 (0.1 to 0.2) | 0.2 (0.1 to 0.3) | 0 (-0.1 to 0.1) |
| Race/ethnicity |  |  |  |  |  |  |  |
| Non-Hispanic white | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Non-Hispanic black | 0.7 (-0.1 to 1.5) | 1.3 (0.2 to 2.4) | -0.1 (-1.1 to 1) |  | 1.4 (0.5 to 2.2) | 2.4 (1.1 to 3.7) | -0.1 (-1.2 to 1.1) |
| Hispanic | 1.4 (0.4 to 2.4) | 1.3 (0 to 2.5) | 1.1 (-0.6 to 2.8) |  | 2.5 (1.2 to 3.7) | 2.5 (0.9 to 4) | 2 (0.1 to 4) |
| Other | -0.9 (-2.3 to 0.5) | -0.9 (-2.8 to 1) | -0.9 (-3 to 1.2) |  | -0.4 (-2 to 1.2) | -0.8 (-3 to 1.4) | 0.2 (-2.2 to 2.5) |
| Household income |  |  |  |  |  |  |  |
| <$25,000 | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| $25,000-<$75,000 | 0.1 (-0.7 to 0.8) | 0.3 (-0.8 to 1.5) | -0.3 (-1.4 to 0.9) |  | -0.2 (-1 to 0.7) | 0.2 (-1.3 to 1.6) | -0.5 (-1.8 to 0.8) |
| ≥$75,000 | -0.3 (-1.3 to 0.8) | -0.1 (-1.5 to 1.4) | -0.7 (-2.2 to 0.9) |  | -0.4 (-1.7 to 1) | -0.2 (-2 to 1.6) | -0.9 (-2.8 to 1) |
| Education |  |  |  |  |  |  |  |
| <High school | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| High school | 0 (-0.8 to 0.8) | -1.1 (-2.4 to 0.2) | 0.9 (-0.3 to 2) |  | -0.1 (-1.1 to 0.9) | -1.5 (-3.3 to 0.3) | 0.9 (-0.4 to 2.2) |
| >High school | -0.2 (-1.3 to 0.8) | -2 (-3.3 to -0.7) | 1.4 (0.2 to 2.5) |  | -0.7 (-1.9 to 0.6) | -2.7 (-4.5 to -1) | 1.4 (0.1 to 2.6) |
| Physically Active3 |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | -1.4 (-2.1 to -0.7) | -1.2 (-2.4 to -0.1) | -1.6 (-2.3 to -0.8) |  | -1.6 (-2.4 to -0.8) | -1.4 (-2.7 to 0) | -1.7 (-2.6 to -0.9) |
| Television Viewing, hours/day2 | 0.4 (0.2 to 0.6) | 0.4 (0.1 to 0.7) | 0.6 (0.3 to 0.8) |  | 0.5 (0.2 to 0.7) | 0.4 (0 to 0.8) | 0.7 (0.4 to 1) |
| Computer Use, hours/day2 | 0.3 (0.1 to 0.6) | 0.3 (0 to 0.7) | 0.4 (0 to 0.7) |  | 0.3 (0 to 0.7) | 0.4 (-0.1 to 0.8) | 0.4 (-0.1 to 0.9) |
| Smoke status |  |  |  |  |  |  |  |
| Never smoking | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Past |  |  |  |  |  |  |  |
| < 20 pack-years | 0.1 (-0.9 to 1.1) | 0.8 (-0.9 to 2.6) | -0.6 (-1.7 to 0.5) |  | 0.5 (-0.7 to 1.8) | 1.2 (-1 to 3.4) | -0.2 (-1.5 to 1.2) |
| ≥ 20 pack-years | 1.9 (0.3 to 3.5) | 6.1 (2.1 to 10.2) | 1.2 (-0.3 to 2.8) |  | 2.4 (0.4 to 4.4) | 7.6 (3.1 to 12.2) | 1.6 (-0.4 to 3.6) |
| without pack-year information | 0.6 (-2.2 to 3.4) | 2 (-0.5 to 4.4) | -1.1 (-5.8 to 3.5) |  | 0.8 (-2.9 to 4.5) | 2.4 (-0.6 to 5.4) | -1.4 (-7.4 to 4.7) |
| Current |  |  |  |  |  |  |  |
| < 20 pack-years | -0.8 (-1.8 to 0.2) | -0.5 (-1.6 to 0.5) | -1.5 (-3.6 to 0.5) |  | -0.5 (-1.6 to 0.6) | -0.1 (-1.4 to 1.2) | -1.8 (-4.1 to 0.6) |
| ≥ 20 pack-years | -1.6 (-2.8 to -0.5) | -0.9 (-2.8 to 1.1) | -2.4 (-3.8 to -1.1) |  | -1.3 (-2.8 to 0.3) | -0.6 (-3.5 to 2.3) | -2.2 (-4 to -0.4) |
| Menopause status |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 1.3 (0.4 to 2.3) | 0.9 (-1 to 2.7) | 2 (0.9 to 3.2) |  | 1.3 (0.2 to 2.5) | 1.4 (-0.9 to 3.7) | 2.2 (0.7 to 3.7) |
| Hypertension |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 1.9 (1.1 to 2.7) | 2 (0.8 to 3.1) | 1.9 (1 to 2.7) |  | 3 (2.2 to 3.9) | 3.2 (1.8 to 4.7) | 2.9 (1.9 to 3.9) |
| High cholesterol |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 0.9 (0.2 to 1.5) | 1.6 (0.4 to 2.7) | 0.5 (-0.4 to 1.4) |  | 1.5 (0.7 to 2.3) | 2.6 (1.1 to 4) | 0.9 (-0.2 to 2) |
| Heart disease |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | -0.2 (-1.7 to 1.2) | 1.4 (-5.1 to 7.9) | -0.1 (-1.5 to 1.3) |  | -0.7 (-2.4 to 1.1) | 1.7 (-5.5 to 9) | -0.5 (-2.1 to 1.2) |
| Osteoarthritis |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 1.2 (0.4 to 2) | 1.5 (0.2 to 2.8) | 1.3 (0.4 to 2.2) |  | 1.2 (0.3 to 2) | 1.6 (0 to 3.2) | 1.3 (0.2 to 2.3) |
| Stroke |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | -0.7 (-2.5 to 1.2) | -3.6 (-5.4 to -1.8) | 0.4 (-1.7 to 2.5) |  | -0.5 (-2.7 to 1.6) | -4.3 (-7.4 to -1.2) | 0.9 (-1.5 to 3.3) |
| Diabetes |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 0.4 (-0.9 to 1.7) | 2.2 (-1.1 to 5.6) | -0.2 (-1.4 to 1.1) |  | 1.6 (0.1 to 3) | 4.6 (1 to 8.3) | 0.9 (-0.5 to 2.2) |
| Cancer |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | -0.3 (-1.4 to 0.7) | -0.1 (-2.8 to 2.6) | -0.4 (-1.4 to 0.7) |  | -0.5 (-1.8 to 0.8) | -0.1 (-3.7 to 3.5) | -0.5 (-1.8 to 0.9) |
| Total energy intake, per 100 kcal/day2 | -0.5 (-1 to 0) | -0.5 (-1.1 to 0.1) | -0.5 (-1.1 to 0.2) |  | -0.6 (-1.2 to -0.1) | -0.6 (-1.2 to 0.1) | -0.7 (-1.5 to 0.2) |
| Sugar in coffee2 | 0 (-0.2 to 0.2) | 0 (-0.5 to 0.4) | 0 (-0.2 to 0.3) |  | 0.1 (-0.2 to 0.4) | 0 (-0.5 to 0.4) | 0.1 (-0.2 to 0.4) |
| Sweeten in coffee2 | 0.2 (-0.1 to 0.5) | 0.4 (-0.3 to 1) | 0.1 (-0.3 to 0.4) |  | 0.3 (0 to 0.7) | 0.4 (-0.4 to 1.1) | 0.3 (-0.2 to 0.8) |
| Creamer in coffee2 | 0.2 (-0.1 to 0.5) | 0 (-0.5 to 0.4) | 0.3 (-0.1 to 0.7) |  | 0.4 (0 to 0.8) | 0.1 (-0.4 to 0.7) | 0.4 (-0.1 to 0.9) |
| Half and half in coffee2 | 0.4 (0 to 0.9) | 0.6 (0 to 1.3) | 0.3 (-0.3 to 0.9) |  | 0.5 (-0.2 to 1.1) | 1 (0.1 to 1.8) | -0.1 (-0.8 to 0.7) |
| Milk in coffee2 | -0.3 (-0.7 to 0.2) | -0.6 (-1.1 to 0) | -0.1 (-0.6 to 0.3) |  | -0.2 (-0.7 to 0.3) | -0.5 (-1.1 to 0.1) | -0.1 (-0.7 to 0.5) |
| Soda during summer2 | 0.6 (0.3 to 1) | 0.8 (0.2 to 1.3) | 0.6 (0.1 to 1.1) |  | 0.8 (0.3 to 1.3) | 1 (0.3 to 1.7) | 0.6 (0.1 to 1.2) |
| Soda during other seasons2 | -0.1 (-0.5 to 0.3) | -0.3 (-0.8 to 0.2) | 0 (-0.6 to 0.6) |  | -0.2 (-0.8 to 0.4) | -0.6 (-1.3 to 0.1) | 0.1 (-0.6 to 0.8) |
| Beer during summer2 | 0.2 (-0.7 to 1.1) | 0.4 (-0.7 to 1.4) | -0.3 (-1.7 to 1.1) |  | 0.3 (-0.7 to 1.3) | 0.5 (-0.8 to 1.7) | -0.2 (-2.3 to 1.8) |
| Beer during other seasons2 | -0.8 (-1.6 to 0) | -0.7 (-1.6 to 0.2) | -0.4 (-1.8 to 1.1) |  | -0.7 (-1.5 to 0.1) | -0.7 (-1.7 to 0.3) | -0.1 (-2.1 to 1.9) |
| Wine during summer2 | -0.8 (-2.4 to 0.8) | 0.3 (-1.4 to 2) | -2 (-3.2 to -0.9) |  | -0.8 (-2.5 to 1) | 0.2 (-2.1 to 2.6) | -2 (-3.6 to -0.4) |
| Liquor2 | -0.8 (-2.1 to 0.5) | -0.3 (-2.7 to 2.1) | -0.8 (-2.3 to 0.7) |  | -0.2 (-1.5 to 1.1) | 0.4 (-2.6 to 3.3) | -0.1 (-1.7 to 1.4) |
| Hot tea2 | -0.4 (-0.8 to 0) | -0.3 (-0.8 to 0.3) | -0.3 (-0.8 to 0.2) |  | -0.7 (-1.2 to -0.3) | -0.6 (-1.3 to 0.1) | -0.7 (-1.2 to -0.1) |
| Ice tea2 | 0.4 (0.1 to 0.6) | 0.4 (0 to 0.8) | 0.4 (0.1 to 0.7) |  | 0.4 (0.1 to 0.8) | 0.6 (0 to 1.1) | 0.4 (0 to 0.8) |
| Healthy Eating Index-20102 | 0 (-0.1 to 0) | 0 (-0.1 to 0) | 0 (-0.1 to 0) |  | 0 (-0.1 to 0) | 0 (-0.1 to 0) | -0.1 (-0.1 to 0) |
| Intention to lose weight |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 2.3 (1.7 to 3) | 2.4 (1.6 to 3.3) | 2.1 (1.3 to 2.8) |  | 3.1 (2.3 to 3.8) | 3.1 (2.1 to 4.1) | 2.7 (1.8 to 3.6) |
| Intention to control weight |  |  |  |  |  |  |  |
| No | 0 [Reference] | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] | 0 [Reference] |
| Yes | 0.7 (-0.1 to 1.4) | 0.9 (-0.1 to 1.9) | 0.3 (-0.5 to 1) |  | 0.9 (0.1 to 1.7) | 1.2 (0 to 2.4) | 0.3 (-0.5 to 1.1) |
| 1 Coffee consumption measured in cup/day; one cup approximately equals to 236.59 mL in the US.  2 Continuous variables in the model.  3 Physically active was defined as engaging in moderate or vigorous recreational physical activity over the past 30 days | | | | | | | |

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| **Supplemental Table 3. Association of Coffee Consumption and Body Fat Percentage Among Non-smokers and Adults Without Chronic Diseases, NHANES 2003-20061,2** | | | | | |
|  | **β-Coefficient (95% CI)** | | | | |
|  | **Men** | |  | **Women** | |
|  | **Non-smokers** | **Diseases Free** |  | **Non-smokers** | **Diseases Free** |
|  | **N=924** | **N=1726** |  | **N=1345** | **N=1835** |
| **Total body fat %** |  |  |  |  |  |
| None | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |
| 0-0.25 cup/day | -0.1 (-1.3 to 1.1) | -0.4 (-1.3 to 0.4) |  | -1.0 (-2.1 to 0.2) | -0.7 (-1.9 to 0.5) |
| 0.25-1 cup/day | -0.4 (-1.6 to 0.8) | -0.3 (-1.2 to 0.6) |  | -1.5 (-2.9 to -0.1) | -0.9 (-2.0 to 0.2) |
| 1 cup/day | 0.4 (-1.2 to 1.9) | 0.2 (-0.9 to 1.3) |  | -1.4 (-2.6 to -0.2) | -0.8 (-1.7 to 0.1) |
| 2-3 cups/day | 0.9 (-0.5 to 2.3) | -0.1 (-1.2 to 0.9) |  | -2.8 (-4.0 to -1.7) | -2.0 (-2.9 to -1.1) |
| 4+ cups/day | 1.0 (-1.0 to 3.0) | 0.1 (-1.5 to 1.7) |  | -2.6 (-4.9 to -0.3) | -2.7 (-4.0 to -1.3) |
| *P* for trend3 | 0.20 | 0.89 |  | <0.001 | <0.001 |
| **Trunk body fat %** |  |  |  |  |  |
| None | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |
| 0-0.25 cup/day | -0.2 (-1.7 to 1.3) | -0.5 (-1.5 to 0.5) |  | -1.1 (-2.7 to 0.4) | -0.9 (-2.3 to 0.6) |
| 0.25-1 cup/day | -0.5 (-1.8 to 0.8) | -0.2 (-1.3 to 0.9) |  | -2.2 (-3.7 to -0.6) | -1.4 (-2.5 to -0.2) |
| 1 cup/day | 0.5 (-1.3 to 2.2) | 0.3 (-0.9 to 1.6) |  | -1.5 (-2.9 to 0) | -0.9 (-2.0 to 0.3) |
| 2-3 cups/day | 1.0 (-0.6 to 2.6) | -0.2 (-1.3 to 1.0) |  | -3.4 (-4.9 to -1.8) | -2.8 (-4.0 to -1.5) |
| 4+ cups/day | 0.7 (-1.7 to 3.1) | 0.1 (-1.7 to 1.9) |  | -3.3 (-6.1 to -0.5) | -4.3 (-6.0 to -2.5) |
| *P* for trend3 | 0.26 | 0.87 |  | <0.001 | <0.001 |
| 1 All multivariable-adjusted (MV-adjusted) models wereconducted adjusting for age (continuous), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian, others), household income (<$25,000, $25,000 to $74,999, and ≥ $75,000), physically active (yes/no), television view daily hours (continuous), computer use daily hours (continuous), educational attainment (< high school, high school, and > high school), smoking status (never smoking, past < 20 pack-years, past ≥20 pack-years, past without pack-year information, current < 20 pack-years, and current ≥ 20 pack-years), menopause status (women only, yes/no), comorbidity (hypertension, high blood cholesterol, coronary heart diseases, osteoarthritis, stroke, and diabetes), frequency of coffee added sugar/creamer/milk use, consumption of soda beverage (continuous), consumption of alcohol intake (wine, beer, and liquor), consumption of hot/ice tea (continuous), total energy intake (continuous), the Healthy Eating Index 2010(continuous) and intention to lose/control weight (yes/no).  2 Coffee consumption measured in cup/day; one cup approximately equals to 236.59 mL in the US.  3 *P* for trend was calculated using the daily coffee consumption as a continuous variable (cups/day). | | | | | |

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| **Supplemental Table 4. Association of Coffee Consumption and Body Fat Percentage According to Decaffeinated Coffee Drinking, NHANES 2003-20061,2** | | | | | |
|  | **β-Coefficient (95% CI)** | | | | |
|  | **Men** | |  | **Women** | |
|  | **Caffeinated3** | **Decaffeinated3** |  | **Caffeinated3** | **Decaffeinated3** |
|  | **N=2480** | **N=974** |  | **N=2862** | **N=1415** |
| **Total body fat %** |  |  |  |  |  |
| None | 0 [Reference] | 0 [Reference] |  | 0 [Reference] | 0 [Reference] |
| 0-0.25 cup/day | -0.4 (-1.2 to 0.4) | -0.8 (-3.3 to 1.8) |  | -0.3 (-1.5 to 0.9) | -2.8 (-4.8 to -0.9) |
| 0.25-1 cup/day | -0.3 (-1.1 to 0.5) | 0.9 (-0.9 to 2.8) |  | -0.7 (-1.7 to 0.3) | -2.4 (-4.5 to -0.2) |
| 1 cup/day | 0.3 (-0.6 to 1.2) | 1.5 (-0.3 to 3.3) |  | -0.8 (-1.7 to 0.1) | -3.0 (-4.5 to -1.5) |
| 2-3 cups/day | -0.2 (-1.0 to 0.7) | 2.1 (0 to 4.2) |  | -1.9 (-2.7 to -1.0) | -3.4 (-5.3 to -1.5) |
| 4+ cups/day | 0.1 (-1.3 to 1.5) | 1.5 (-2.2 to 5.1) |  | -2.7 (-4.2 to -1.2) | -2.2 (-5.5 to 1.1) |
| *P* for trend4 | 0.893 | 0.078 |  | <0.001 | <0.001 |
| **Trunk body fat %** |  |  |  |  |  |
| None |  |  |  |  |  |
| 0-0.25 cup/day | -0.4 (-1.4 to 0.5) | -1.2 (-4.5 to 2.0) |  | -0.3 (-1.8 to 1.1) | -3.4 (-5.6 to -1.2) |
| 0.25-1 cup/day | -0.2 (-1.2 to 0.7) | 1.4 (-0.8 to 3.6) |  | -1.2 (-2.4 to -0.1) | -3.0 (-5.2 to -0.7) |
| 1 cup/day | 0.3 (-0.7 to 1.3) | 1.7 (-0.3 to 3.7) |  | -1.0 (-2.1 to 0.1) | -4.0 (-5.8 to -2.2) |
| 2-3 cups/day | -0.1 (-1.1 to 0.8) | 2.0 (-0.6 to 4.5) |  | -2.7 (-3.8 to -1.6) | -4.1 (-6.4 to -1.8) |
| 4+ cups/day | 0 (-1.5 to 1.5) | 1.3 (-4.0 to 6.5) |  | -4.3 (-6.1 to -2.6) | -4.6 (-9.2 to 0.1) |
| *P* for trend4 | 0.939 | 0.160 |  | <0.001 | <0.001 |
| 1 All multivariable-adjusted (MV-adjusted) models wereconducted adjusting for age (continuous), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian, others), household income (<$25,000, $25,000 to $74,999, and ≥ $75,000), physically active (yes/no), television view daily hours (continuous), computer use daily hours (continuous), educational attainment (< high school, high school, and > high school), smoking status (never smoking, past < 20 pack-years, past ≥20 pack-years, past without pack-year information, current < 20 pack-years, and current ≥ 20 pack-years), menopause status (women only, yes/no), comorbidity (hypertension, high blood cholesterol, coronary heart diseases, osteoarthritis, stroke, and diabetes), frequency of coffee added sugar/creamer/milk use, consumption of soda beverage (continuous), consumption of alcohol intake (wine, beer, and liquor), consumption of hot/ice tea (continuous), total energy intake(continuous), the Healthy Eating Index 2010(continuous) and intention to lose/control weight (yes/no). | | | | | |
| 2 Coffee consumption measured in cup/day; one cup approximately equals to 236.59 mL in the US. | | | | | |
| 3 The sample size included the non-coffee drinkers. | | | | | |
| 4 *P* for trend was calculated using the daily coffee consumption as a continuous variable (cups/day). | | | | | |