Original Paper

Evening Eating and Its Relation to Self-Reported Body Weight and Nutrient Intake in Women, CSFII 1985–86

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Objective: We investigated the association of extent of daily energy intake from evening food intake with self-reported body weight and nutrient intake.

Design: Using data from the 1985–86 CSFII, we estimated the proportion of daily energy from foods/beverages reportedly consumed after 5 p.m. on 4 non-consecutive days by 1802 women, aged 19–50 years.

Results: The mean ± SE of 4-day average energy from evening food intake was 46 ± 0.4%. Body mass index was not associated with percent energy from evening food intake in unadjusted or multiple-covariate-adjusted regression analyses. In multiple-covariate-adjusted regression models, percent energy from fat, protein, and grams of alcohol reported were positively associated with percent energy from evening food intake ($p < 0.05$); while percent energy from carbohydrate, and percent RDA of vitamins C, B-6, and folate were inversely associated with evening eating.

Conclusions: The results do not support the hypothesis regarding the association of relative weight with percent energy from evening food intake. However, statistically significant differences in intake of some nutrients in relation to extent of evening food intake were noted.

INTRODUCTION

Nutritionists generally recommend that one should obtain one's daily energy and nutrient needs from three or more meals (eating occasions) per day. It is commonly assumed that such a distribution of food intake into meals will increase the ability to meet nutrient requirements and promote a feeling of well-being. Interestingly, we could find no articulation or substantiation of this notion in the published literature, except in relation to recommendations for disease states such as diabetes mellitus [1]. In the US, the largest proportion of the daily food and energy intake is often consumed in the evening. However, few published estimates of this proportion or the relation of extent of evening eating with nutrient intake could be found.

Further, Halberg [2] has suggested that the metabolic efficiency of energy utilization from macronutrients may show circadian variability. Energy intake in the morning after awakening was found to lead to higher weight loss relative to when the same intake occurred in the evening [2]. Romon et al recently reported that thermic effect of food (TEF) of isocaloric loads was significantly higher in the morning relative to afternoon or evening [3]. These observations suggest that the distribution of daily energy (food) intake may affect energy expenditure, energy storage, and therefore body weight.

The purpose of our study was to examine: 1) the proportion of daily energy from evening food intake; 2) the association of self-reported body weight with percent energy intake from evening food consumption and; 3) the association of nutrient intake profiles with percent energy from evening food intake in a large group of women aged 19–50 years.

METHODS

We used data from the US Department of Agriculture (USDA) 1985–1986 Continuing Surveys of Food Intakes By Individuals (CSFII) [4,5]. The CSFII 1985–86 surveys included women 19–50 years of age and their children aged 1 to

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5 years [4,5]. The CSFII 1985–86 was derived from both low-income and general populations and was designed to collect 6 non-consecutive days of dietary data over a 1-year period. The first day of dietary data was collected by an interviewer administered (in-person) 24-hour recall; subsequent 24-hour recalls were collected via telephone. Information on income, education, smoking status, race, physical activity, self-perceived health status, body weight, height, and employment status was also obtained at the first interview.

Analytic Sample

For the purpose of analyses reported in this study, all women from the core (general population) with 4 complete days of dietary data were considered eligible (n = 2134). From this eligible cohort we excluded women who were pregnant or lactating at the time of the survey (n = 228); also excluded were women with more than 2 sick days on the days of dietary recall (n = 39). Women who could not report body weight (n = 13), or time of day for foods consumed were also excluded (n = 52) leaving 1802 women in the final analytic sample.

Timing of Meals

As part of the 24-hour dietary recall, respondents were asked to recall the time of day at which food/beverage was reportedly consumed. We defined three time periods (morning, midday, and evening) for food ingestion from the times reported. All food consumed from the first reported time to 10:59 a.m. was in the morning period; the midday period included all foods ingested from 11:00 a.m. to 4:59 p.m.; the evening period included foods ingested from 5:00 p.m. till the last reported time on the recalled day. The night period included foods ingested from 8:00 p.m. to last reported time on the recalled day.

Statistical Analysis

Percent of total daily energy from foods consumed in the three time periods (morning, midday, and evening) was calculated for each reported day of intake and a 4-day average was obtained. Using tertile cuts (thirds) of 4-day average percent of daily energy from evening food intake, the respondents were divided into low, middle, and high intake levels of evening food intake. Mean intake (4-day average) of selected nutrients (% energy from macronutrients, fiber, vitamins A, C, E, B-6, folate, and the minerals calcium, iron, and zinc) by tertiles of percent of daily energy from evening food intake were obtained. A nutrient adequacy score (NAS) was calculated based on the number of nutrients (from a total of 8) for which at least 2/3 RDA was consumed. Descriptive statistics for 4-day average percent of daily energy from the three time periods by age, race, education, smoking status, and body mass index (BMI) were also obtained. Regression analyses with and without adjustment for other factors potentially related to body weight were performed with BMI as a dependent variable and percent of daily energy from evening food intake as independent variable. Other potential confounders included age, race, total energy intake, alcohol intake, physical activity, and smoking status. The association of energy and nutrient intake with percent energy from evening food intake was examined using regression analyses where each nutrient intake was a dependent variable and percent energy from evening food intake, total energy intake, age, and alcohol intake were predictor variables.

All statistical analyses were performed using SAS [6], and the appropriate sample weights provided with the USDA data tape [4,5]. Statistical software suitable for analyses of survey data (SESUDAAN, and SURREGR) were utilized to obtain estimates of variance and standard errors of regression coefficients [7,8].

RESULTS

Women in the CSFII aged 19 to 50 years consumed a mean of 18% of their daily energy intake from morning (before 11:00 a.m.), 36% from midday (11:00–4:59 p.m.), and 46% from evening (at or after 5:00 p.m.) food intake (Table 1). Over one third of all respondents consumed >50% of their daily energy

Table 1. Mean ± SE of Body Mass Index (BMI), Total Daily Energy, and Percentage of Energy Intake from Morning[1], Midday[2], Evening[3], and Night[4] Periods by Tertiles of Percent of Daily Energy from Evening Food Intake, CSFII 1985–86, Women 19–50 Years

	Tertiles of % energy from evening food intake			
	All	First <41.4	Second 41.4–52.3	Third ≥52.4
n	1802	600	601	601
Age (years)	35 ± 0.3	35 ± 0.5	35 ± 0.4	35 ± 0.5
BMI[5] (kg/m^2)	24.4 ± 0.4	24.2 ± 0.2	24.4 ± 0.2	24.6 ± 0.3
Energy (kcal)	1479 ± 15	1422 ± 26	1522 ± 22	1494 ± 28
Energy/BMI	64 ± 0.9	61 ± 1.3	65 ± 1.3	64 ± 1.8
Percent energy from:				
Morning	18 ± 0.3	22 ± 0.4	17 ± 0.4	14 ± 0.4
Midday	36 ± 0.4	46 ± 0.5	36 ± 0.4	26 ± 0.4
Evening	46 ± 0.4	32 ± 0.4	47 ± 0.1	60 ± 0.3
Night	12 ± 0.3	9 ± 0.4	11 ± 0.4	16 ± 0.5

[1] morning period included all foods consumed from first reported time to 10:59 a.m.

[2] midday period included all foods consumed between 11:00 a.m. to 4:59 p.m.

[3] evening period included all foods consumed from 5:00 p.m. to last reported time.

[4] night period included all foods reported from 8:00 p.m. to last reported time.

[5] The association of BMI or energy/BMI with percent of energy from evening or night food intake was not significant in age-adjusted (p > 0.05) or multiple-covariate-adjusted (p > 0.0.05) regression models. The multivariate model where BMI (continuous) was a dependent variable included percent energy from evening (or night food intake), total energy intake, age, alcohol intake (all continuous); and race, smoking status, and recreational physical activity (categorical) as independent variables.

intake from food ingested in the evening. Mean percent energy from both morning and midday periods declined with increasing energy from evening food intake.

Body Weight and Evening Eating

A scatter plot of BMI versus 4-day average percent energy from evening food intake for the 1802 respondents is shown in Fig. 1. Mean ± SE of BMI associated with each tertile of percent daily energy from evening eating is shown in Table 1. Regression analyses revealed no association of BMI with % energy from evening food intake in unadjusted (regression coefficient = 0.01, $p = 0.43$) or multiple-covariate-adjusted (regression coefficient for percent energy from evening food intake = 0.02, $p = 0.10$) models that included variables for age, race, energy intake, cigarette smoking, alcohol intake, and level of recreational physical activity. In similarly adjusted models, BMI and percent energy from food consumed at night (from 8:00 p.m. onwards) were also not related. Energy intake/BMI was also not associated with percent energy from evening food intake.

Energy and Nutrient Intake and Evening Eating

Energy and nutrient intake associated with tertiles of energy from evening food ingestion are shown in Tables 1 and 2, respectively. A slight positive association (beta for percent energy from evening food intake = 2.52, $p = 0.02$) of total energy intake with percent energy from p.m. eating was noted in age-adjusted models but not after adjustment for alcohol intake. Mean intake of alcohol ($p < 0.0001$), % fat energy ($p = 0.0004$), and % protein energy increased ($p = 0.03$), but mean % energy from carbohydrate decreased ($p = 0.0001$) with increasing amount of percent energy from evening food intake. Dietary fiber intake was not related with the percent of energy from evening food intake.

Dietary intakes (% RDA and nutrient density) of vitamin C, vitamin B-6, and folate were inversely associated with percent of daily energy from evening food intake (Table 2). Intakes of vitamin A, vitamin E, calcium, iron, and zinc were not related ($p > 0.05$) with percent energy from evening food intake. The nutrient adequacy score was also not associated with evening eating.

The proportion of respondents reporting less than 2/3 RDA of vitamins A, C, B-6, and folate was slightly higher in the third tertile of energy from evening food intake (Table 3). Proportion of respondents with low NAS scores was lowest in the second tertile of percent energy from evening food intake.

Socio-Demographic/Lifestyle Factors and Evening Eating

Table 4 lists the mean ± SE of % energy from evening food intake by various socio-demographic and lifestyle factors. Mean % energy from evening food intake was lower in ethnic groups other than black or white, and in respondents with <12 years of education relative to comparison categories. Mean percent energy from evening food intake varied little by age, employment status, occupational or recreational physical activity, and special diet status. Current smokers reported slightly higher mean percent energy from evening food intake relative to former smokers or non-smokers. Respondents describing their health status as fair or poor reported lower mean % energy

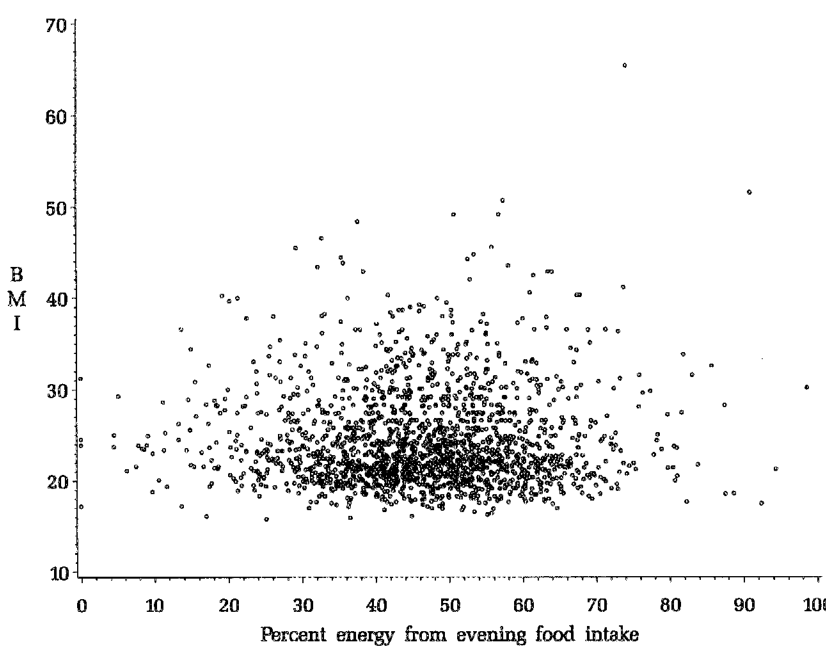

Fig. 1. Scatter plot of body mass index (BMI) versus percent energy from evening food intake, CSFII 1985–86, women 19 to 50 years.

Table 2. Mean ± SE of Intake of Selected Nutrients by Tertiles of Percent of Daily Energy from Evening Food Intake, CSFII 1985–86, Women 19–50 Years

		Tertiles of % energy from evening food intake		
	All	First <41.4	Second 41.4–52.3	Third ≥52.4
n	1802	600	601	601
Percent energy from:				
Fat*	36.1 ± 0.2	35.8 ± 0.3	36.0 ± 0.3	36.5 ± 0.3
Protein*	16 ± 0.1	16 ± 0.2	17 ± 0.1	16 ± 0.2
Carbohydrate*	46 ± 0.3	47 ± 0.4	46 ± 0.4	44 ± 0.4
Alcohol* (g)	4.4 ± 0.4	2.7 ± 0.4	3.2 ± 0.3	7.3 ± 0.8
Fiber				
g	11 ± 0.2	10 ± 0.3	11 ± 0.2	10 ± 0.3
g/1000 kcal	7.3 ± 0.1	7.4 ± 0.1	7.4 ± 0.1	7.2 ± 0.1
Vitamin A				
% RDA	102 ± 3.1	100 ± 4.8	111 ± 4.8	94 ± 4.9
RE/1000 kcal	562 ± 14	571 ± 26	607 ± 22	511 ± 27
Vitamin E				
% RDA	86 ± 1.8	81 ± 3.2	92 ± 3.5	84 ± 2.7
mg/1000 kcal	4.6 ± 0.1	4.5 ± 0.2	4.8 ± 0.1	4.5 ± 0.1
Vitamin C				
% RDA*	126 ± 3.2	128 ± 4.5	128 ± 4.0	121 ± 4.8
mg/1000 kcal*	53 ± 1.1	56 ± 1.3	53 ± 1.7	50 ± 1.7
Vitamin B6				
% RDA*	71 ± 1.0	70 ± 1.7	74 ± 1.3	69 ± 1.5
mg/1000 kcal*	0.8 ± 0.01	0.8 ± 0.01	0.8 ± 0.01	0.8 ± 0.01
Folate				
% RDA*	104 ± 1.6	104 ± 2.6	106 ± 2.1	101 ± 2.6
μg/1000 kcal*	130 ± 1.3	136 ± 2.5	129 ± 1.9	124 ± 2.3
Calcium				
% RDA	70 ± 1.3	69 ± 2.1	73 ± 1.9	69 ± 2.1
mg/1000 kcal	398 ± 5	404 ± 8	403 ± 9	387 ± 9
Iron				
% RDA	66 ± 0.8	64 ± 1.5	69 ± 1.0	65 ± 1.4
mg/1000 kcal	6.9 ± 0.05	6.9 ± 0.1	6.9 ± 0.1	6.7 ± 0.1
Zinc				
% RDA	71 ± 0.9	68 ± 1.7	73 ± 1.1	71 ± 1.3
mg/1000 kcal	5.8 ± 0.05	5.8 ± 0.1	5.9 ± 0.1	5.9 ± 0.1
Nutrient adequacy score (NAS)[a]	4.5 ± 0.1	4.2 ± 0.2	4.9 ± 0.1	4.4 ± 0.1

RDA = 1989 sex-age specific recommended dietary allowance

* The regression coefficient for percent energy from evening food intake was significant. In separate regression models for each nutrient, the nutrient was entered as a dependent variable (continuous); percent energy from evening food intake, total energy intake, alcohol intake, and age (all continuous) were included as predictor variables. The regression coefficients associated with percent energy from evening food intake with following nutrients as dependent variables were: fat 0.05, p = 0.0004; protein 0.01, p = 0.03; carbohydrate −0.02, p = 0.0001; alcohol 0.10, p = 0.0000; % RDA vitamin C −0.40, p = 0.003; % RDA vitamin B-6 −0.09, p = 0.03; % RDA folate −0.26, p = 0.0003.

[a] NAS counts the number of nutrients (from a total of 8) for which at least 2/3 RDA was reported.

from evening food intake relative to those reporting excellent, very good or good health status.

DISCUSSION

This study provides estimates of proportion of daily energy from evening food intake for a large sample of women aged 19 to 50 years. Approximately 46% of daily energy intake was estimated to come from foods/beverages reportedly consumed in the evening. These estimates are derived using replicate measures of dietary intake obtained on 4 non-consecutive days over 1 year that included weekdays and weekend days. The results are consistent with casual observations as well as results of the 1977–78 NFCS [9]. Nearly 70% of women aged 23–50 years in the 1977–78 NFCS reported the evening meal to be their most energy-dense meal [9]. Dreon et al [10] also estimated a mean of 48% of daily energy intake from dinner and post-dinner food intake in 155 sedentary, obese men. However, we know of no other estimates to enable a direct comparison. Any future comparison of these estimates with other estimates of a similar nature should consider that all foods/beverages

Table 3. Percentage of Population Consuming Less than Two-Thirds of the (RDA[a]) of Selected Nutrients, and in Categories of Nutrient Adequacy Score (NAS[b]) by Tertiles of Daily Energy from Evening Food Intake, CSFII 1985–86, Women 19–50 Years

	Tertiles of % energy from evening food intake			
	All	First <41.4	Second 41.4–52.3	Third ≥52.4
			%	
Vitamin A	42	43	38	46
Vitamin E	41	46	35	42
Vitamin C	26	28	22	29
Vitamin B-6	51	54	46	54
Folate	21	23	17	24
Calcium	52	55	49	53
Iron	57	61	53	58
Zinc	50	55	43	51
NAS 0–3	37	39	32	39
NAS 4–6	32	32	32	32
NAS 7–8	31	28	36	29

[a] RDA = sex-age specific 1989 RDA

[b] NAS counts the number of nutrients (from a total of 8) for which at least 2/3 RDA was reported.

consumed in a defined period (without distinctions between meals or snacks) were used to arrive at these estimates.

Contrary to hypotheses proposed by Halberg [2], and Romon et al [3], there was no association between percent energy from evening food intake and relative weight (BMI) in our study (Table 1, and Fig. 1). Further, percent energy consumed at night (8:00 p.m. and later; possibly representing after dinner snacking) also was not related with BMI in unadjusted or fully adjusted models (Table 1). Our results, however, are in accordance with the observations of Dreon et al [10] who noted no correlations between distribution of food intake and BMI or percent body fat in obese men. Also, unlike Romon et al [3], Zwiauer et al [11] found no differences between morning and afternoon TEF in response to an isocaloric meal.

Because estimates of body fatness or indices of body fat distribution are not available for CSFII respondents, the possibility that distribution of food intake may relate with measures of adiposity that are not necessarily measured by BMI, could not be examined in this data set. However, as noted above, Dreon et al [10] did not observe an association between distribution of food intake and percent body fat in 155 middle-aged obese men.

The data presented are cross-sectional and permit no conclusions regarding the long-term effect of consumption of a large proportion of daily energy intake from evening food intake on body weight. Further, some reports suggest that overweight individuals may underreport their food intake [12]. If this underreporting is selective for time of day, then the estimates of evening food consumption may be biased due to body weight. To our knowledge, however, evidence to support this contention is not available.

Table 4. Mean ± SE of Percent of Daily Energy from Evening Food Consumption by Socio-Demographic and Lifestyle Characteristics, CSFII 1985–86, Women 19–50 Years

	n	% Energy from evening eating
Race		
White	1562	47 ± 0.4
Black	142	46 ± 2.0
Other	67	41 ± 1.6
Age (years)		
19–34	863	47 ± 0.6
35–50	939	46 ± 0.6
Education (years)		
<12	74	41 ± 1.4
12	955	46 ± 0.6
College	648	47 ± 0.5
Postgraduate	117	46 ± 1.1
Employment status		
Full-time	799	47 ± 0.5
Part-time	345	45 ± 0.7
None	621	46 ± 0.7
Smoking status		
Never	967	45 ± 0.5
Former	262	47 ± 1.1
Current	572	48 ± 0.7
Self-described health status		
Excellent	681	47 ± 0.6
Very good	572	46 ± 0.7
Good	385	46 ± 0.8
Fair	127	44 ± 1.2
Poor	34	41 ± 2.3
Self-described level of physical activity (occupational)		
Heavy	331	46 ± 0.8
Moderate	1002	46 ± 0.5
Light	462	47 ± 0.7
Self-described level of physical activity (recreational)		
Heavy	173	46 ± 1.1
Moderate	927	47 ± 0.5
Light	694	46 ± 0.6
Special diet status		
Yes	246	46 ± 1.0
No	1554	46 ± 0.4

Our estimates of relative weight (BMI) are derived from self-reported weight and height. Generally, self-reported body weight and height have been found to be highly correlated with measured weight and height [13,14]. However, reporting errors (underreporting of body weight and overreporting of height) have been shown to increase with extent of overweight [14]. Thus, reporting bias due to body weight status may possibly attenuate the association of body weight and percent energy from evening eating.

Highest mean daily energy and percent RDA of nearly all examined nutrients was associated with the second tertile of percent of daily energy from evening food intake. The associations of dietary fat, carbohydrate, protein, vitamin C, vitamin

B-6, and folate intakes with percent energy from evening food intake were significant after adjusting for age, total energy, and alcohol intake. In multiple-covariate-adjusted regression models, total energy intake and alcohol intake were stronger predictors of nutrient intake than was the percent of energy from evening food intake. Expectedly, energy intake was a positive predictor and alcohol intake a negative predictor of nutrient intake. (Data for association of energy intake with nutrient and alcohol intake are not shown.) Although evening eating associated differences in nutrient intake were relatively small (as evident from regression coefficients reported in Table 2), it is possible that respondents reporting bulk of their energy intake in the evening will find it difficult to attain the recommended goals for fruit and vegetable intake [15].

In conclusion, the results of our study do not support the hypothesis regarding the positive association of body weight with increased energy (food) intake in the evening. Food (energy) distribution may be important for assuring adequacy of intake of vitamins C, B-6, and folate. Also, higher alcohol intake with increasing percent energy from evening food intake may be of concern due to the inverse association of alcohol and nutrient intake observed in this study. Further research on association of energy distribution with measures of body fatness (other than BMI); and the ability to meet food group goals in current dietary guidance is needed.

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