

Dietary Behaviors, Psychological Well-Being, and Mental Distress Among University Students in ASEAN

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Abstract

Background: Dietary intake is important for physical and mental health.

Objectives: The purpose of the study was to investigate the effect of dietary behaviors on psychological well-being and mental distress in a large cross-national sample of university students from five ASEAN countries (Indonesia, Malaysia, Myanmar, Thailand, and Vietnam)

Methods: In this cross-sectional survey, 3357 university students (Mean age = 20.5 years, SD = 1.6), who were randomly selected, responded to a questionnaire including measures of dietary behaviors, psychological well-being, and mental distress.

Results: In analysis of covariance, adjusted for age, sex, subjective socioeconomic status, country, body mass index (BMI), and physical activity, positive dietary behaviors (fruit and vegetable consumption, daily breakfast, fat avoidance, and eating foods high in fiber) were associated with happiness, life satisfaction, and self-reported health. Fruit consumption and regular breakfast were negatively associated with depression and traumatic stress symptoms. Unhealthy dietary behaviors (soft drinks, fast foods, and eating snacks) were associated with unhappiness, low life satisfaction, and depression symptoms.

Conclusions: Overall, the study found some evidence indicating that healthier dietary behaviors were associated with higher psychological well-being and lower mental distress, suggesting that a diet intervention may be helpful in preventing or alleviating mental distress in this ASEAN university student population.

Keywords: ASEAN, Dietary Intake, Mental Stress, Psychological Well-Being, University Students

1. Background

There has been a recent increase in studies linking dietary behaviors to psychological well-being and mental distress (1, 2). Specific healthy dietary behaviors (e.g. fruit and vegetable consumption, regular/daily breakfast, number of meals eaten daily, and fat avoidance) have been found positively associated with happiness, life satisfaction, and self-reported health (1-4), and fruit and vegetable consumption, fiber intake, and regular breakfast consumption were negatively associated with mental and psychological distress and depression (2, 5, 6). Furthermore, specific unhealthy dietary behaviors (consumption of soft drinks, fast foods, sweets, and snacks) were associated with unhappiness, low life satisfaction, mental and psychological distress, and depression (5, 7-9).

For example, among European university students, perceived stress was associated with more frequent consumption of sweets/fast foods and less frequent consumption of fruits/vegetables, and depressive symptoms were associated with less frequent consumption of fruits/vegetables and meat (5). In a study among Iranian

children and adolescents, the frequency of junk food consumption (sweets, sweetened beverages, fast foods, and salty snacks) was significantly associated with psychiatric distress (8). While a study on adolescents in Norway found a J-shaped dose-response relationship between soft drink consumption and mental distress and mental health difficulties scores (10). We have limited information on the relationship between dietary behaviors, psychological well-being, and mental distress in Southeast Asia, which prompted this study. It is hypothesized that healthy dietary behaviors enhance psychological well-being and reduce mental distress.

2. Objectives

The current investigation adds to the limited studies on this subject by using a large sample of university students in ASEAN to estimate the effect of dietary behaviors on psychological well-being and mental distress.

3. Materials and Methods

3.1. Study Design and Settings

In a cross-sectional survey, a questionnaire on a range of health behaviors was self-administered and anthropometric measurements were taken among university students in five ASEAN countries.

3.2. Participants

Study collaborators arranged for data to be collected from intended 700 undergraduate university students aged 16 - 30 years by trained research assistants in 2015 in one university per country in Indonesia, Malaysia, Myanmar, Thailand, and Vietnam. The sample size was calculated using Epi-Info Version 7.1 (centers for disease control and prevention, Atlanta, GA; USA). For the population survey, the minimum sample size at confidence level of 99% was calculated as 663.

3.3. Study Procedure

In each participating country, undergraduate students were surveyed in their language in classrooms (inclusion criteria: all students present in class) selected through a stratified random sampling procedure (one university department randomly chosen from each faculty as "primary sampling unit", and for each selected department randomly ordered undergraduate courses). Participation rates were in all countries more than 90%, except for Indonesia with 69% and Myanmar with 73%.

3.4. Questionnaires

Three measures of psychological well-being (happiness, life satisfaction, and self-rated health) and two measures of psychological distress (stress symptoms and depression) were investigated in this study.

A 4-item subjective happiness scale (SHS) (11) was used. Response options ranged from 1 = strongly disagree to 5 = strongly agree. A single happiness score was computed with the four items (range: 4 - 20), with higher scores representing higher levels of happiness. (Cronbach's alpha = 0.76).

Subjective general health status was measured with the question, "In general, would you say your health is...?" (Rated from 1=excellent to 5=poor) and Life satisfaction, "All things considered, how satisfied are you with your life as a whole?" (Rated from 1 = very satisfied to 5 = very dissatisfied) (12).

The "centre for epidemiological studies depression scale (CES-D: 10 items)" was utilized to measure depressive symptoms (13) (Cronbach's alpha = 0.75).

Posttraumatic stress disorder (PTSD) was assessed with Breslau's 7-item screening questionnaire on PTSD symptoms in the past month (14) (Cronbach's alpha = 0.77).

3.4.1. Dietary Behavior Variables

Fruit and vegetable (FV) consumption was measured with 2 items on the number of servings (80 grams) of fruits and vegetables eaten on a typical day (15). Other dietary questions included: (a) number of meals a day, (b) frequency of having breakfast, (c) frequency of having between-meal snacks, (d) "avoiding foods containing fat and cholesterol", (e) trying to eat foods high in fiber, (f) frequency of "eating red meat (beef, pork, lamb, veal, bacon, hamburgers, sausages, etc.)", and (g) frequency of adding salt to meals (12). Consumption of chocolate or candy and sugared coffee or tea was assessed with two questions (Rated from 1 = more than once a day to 6 = never). Soft drink consumption was assessed with the question, "During the past 30 days, how many times per day did you usually drink carbonated soft drinks (do not include diet soft drinks)?" (Rated from 1 = none to 7 = 5 or more times per day) (16). Furthermore, fast food consumption was assessed with the item, "During the past 7 days, on how many days did you eat food from a fast food restaurant?" (Rated from 1 = 0 days to 8 = 7 days) (16).

Socio-demographic variables included age, gender, and subjective socioeconomic status (12).

Anthropometric measurements included students' weight and height that were measured by trained researcher assistants adopting standardized procedures. Body mass index (BMI) was classified according to Asian criteria: normal weight (18.5 to < 23.0), overweight (23.0 to < 25.0), and obese (≥ 25) (17).

Physical activity was measured using the "international physical activity questionnaire (IPAQ) short version, for the last 7 days (IPAQ-S7S)" (18), and scored according to IPAQ manual into low, moderate, and high physical activities (19).

3.5. Statistical Analyses

The data were analyzed using IBM-SPSS for Windows, version 23 (Chicago, Illinois, USA). Descriptive statistics were used to compute the frequency of the study variables of the student population. Analysis of covariance (ANCOVA) was utilized to assess the associations between the 5 measures of positive and negative psychological well-being and 12 dietary behaviors, and adjustments were made for age, gender, socio-economic status, BMI, physical activity, and country.

3.6. Ethical Considerations

Ethics approvals were obtained from all the participating institutions. Informed consent was obtained from each participating student.

4. Results

The sample included 3357 undergraduate university students (Mean age = 20.5 years, SD = 1.6) from five ASEAN countries, ranging from 231 in Indonesia to 1023 in Malaysia. Almost two-thirds of the sample (62.9%) was women and 67.0% came from a less wealthy family background. One in five (22.6%) were overweight or obese and 50.5% engaged in low physical activities. The overall mean score was 13.01 for happiness (range: 4 - 20), 3.91 for life satisfaction (range: 1 - 5), 2.97 for self-rated health (range: 1 - 5), 9.41 for depression symptoms (range: 0 - 30), and 2.00 for PTSD symptoms (range: 0 - 7) (Table 1).

Table 1. Sample Characteristics of University Students, 2015 (N = 3357)

| Variable | No. | % | |
|----------------------------|------------------------------|-------|------|
| Variable name | Variable specification | | |
| Gender | Female | 2112 | 62.9 |
| | Male | 1245 | 37.1 |
| Age in years | 18 -19 | 994 | 29.6 |
| | 20 -21 | 1497 | 44.6 |
| | 22 -30 | 866 | 25.8 |
| | Wealthy/quite well - off | 2248 | 67.0 |
| Family economic background | Quite poor/not very well off | 1109 | 33.0 |
| | Indonesia | 231 | 6.9 |
| Country | Malaysia | 1023 | 30.5 |
| | Myanmar | 486 | 14.5 |
| | Thailand | 800 | 23.8 |
| | Vietnam | 817 | 24.3 |
| | Underweight | 676 | 21.5 |
| Body Mass Index | Normal weight | 1760 | 55.9 |
| | Overweight | 318 | 10.1 |
| | Obese | 394 | 12.5 |
| Physical activity | Low | 1677 | 50.5 |
| | Moderate | 1133 | 34.1 |
| | High | 514 | 15.5 |
| Scale | Range of scores | M | SD |
| Happiness | 4 - 20 | 13.01 | 2.84 |
| Life satisfaction | 1 - 5 | 3.91 | 0.84 |
| Self-rated health | 1 - 5 | 2.97 | 0.84 |
| Depression symptoms | 0 - 30 | 9.41 | 3.96 |
| PTSD symptoms | 0 - 7 | 2.00 | 2.06 |

4.1. Associations of Dietary Behaviors with Happiness and Life Satisfaction

In ANCOVA analysis, adjusted for age, sex, subjective socioeconomic status, country, BMI, and physical activity, positive dietary behaviors (vegetable consumption, eating foods high in fiber) were associated with happiness, and negative dietary behaviors (fast food consumption, having two or more soft drinks a day) were inversely associated

with happiness. Moreover, positive dietary behaviors (eating breakfast almost every day, having three servings of fruits per day, avoiding fat and cholesterol) were associated with life satisfaction, and negative health behaviors (having snacks) were also associated with life satisfaction. Soft drinks consumption had a U shaped association with life satisfaction. Students who had soft drinks less than once a day and twice or more per day had a higher life satisfaction than students who had soft drinks once a day.

Moreover, salt and meat consumption had a reverse U shape association with happiness, and salt consumption had a reverse U shape association with life satisfaction. Students who sometimes had salt had a higher happiness and life satisfaction than students who never or usually had salt. Regarding meat consumption, students who had meat once a week had a higher happiness score than students who never or less than once a week and at least once a day had meat. In addition, sugar consumption in tea or coffee had a U shape association with happiness. Students who had rarely or never and once or more times a day sugar in coffee or tea were happier than students who had 1 to 6 times a week sugar in coffee or tea (Table 2).

Associations of Dietary Behaviors with Self-Reported Health Status, Depression, and PTSD Symptoms

In ANCOVA analysis, adjusted for age, sex, subjective socioeconomic status, country, BMI, and physical activity, positive dietary behaviors (avoiding fat and cholesterol) were associated with positive self-rated health status, and negative dietary behaviors (eating snacks and having soft drinks) were also positively associated with self-rated health status. Moreover, sugar in tea or coffee consumption had a reverse U shape association with self-rated health status. Students who 1 - 6 times a week had sugar in their tea or coffee had a better self-rated health status than students who never and daily had sugar in their tea or coffee.

Furthermore, positive dietary behaviors, including daily breakfast and eating fruits, were inversely and eating foods high in fiber were positively associated with depression symptoms, and negative dietary behaviors (eating snacks) were positively and having chocolate or candy and having sugar in tea or coffee were negatively associated with depression symptoms. Moreover, eating meat had a reverse U shape association with depressive symptoms. Students who never and frequently had meat had more depressive symptoms than students who had meat less than once a week or once a week.

Positive dietary behaviors (daily breakfast) were inversely and eating foods high in fiber were positively associated with PTSD symptoms. Eating fast foods had a U shape association with PTSD symptoms. Students who had fast food once a week had fewer PTSD symptoms than stu-

dents who had not had any fast food or had fast food in two to seven days in the past week (Table 3).

5. Discussion

The study found in partial agreement with previous studies (1-4) that healthy dietary behaviors (fruit and vegetable consumption, regular/daily breakfast, fat avoidance, eating foods high in fiber) have been found positively associated with happiness, life satisfaction, and self-reported health. Furthermore, the study found in agreement with previous studies (2, 5, 6) that fruit consumption and regular breakfast were negatively associated with depression and mental distress (PTSD symptoms). Fruits and vegetables that are rich in antioxidants such as vitamin C and vitamin E, and folic acid and anti-inflammatory components, may enhance human optimism and happiness (20) and may decrease the development of negative mood and depression (21). Skipping breakfast may be associated with increased appetite and overweight (22), and some studies (e.g., (23)) have shown some evidence on the association between depression and skipping breakfast.

Moreover, there was some agreement with previous studies (7-9) that unhealthy dietary behaviors (soft drinks, fast food, and eating snacks) were associated with unhappiness, low life satisfaction, and depression symptoms. Some studies have suggested that an increase in carbohydrate-dense but nutrient-poor foods such as sweets, snacks, and fast food may be used to cope with negative mood and elevate mood by increasing brain serotonin levels (24). Regarding red meat consumption, the study found that a more healthy frequency of meat consumption (once a week) was associated with the highest happiness score and the lowest depressive scores, which was also found in a Scottish health survey (25). Similarly, salt consumption had a reverse U shaped association with happiness and life satisfaction, indicating higher happiness and life satisfaction with a healthy (less than usual) salt consumption pattern. More research is needed to investigate meat and salt consumption in relation to well-being.

However, several counter intuitive associations were also found. For instance, regarding healthy dietary behaviors, eating foods high in fiber was associated with more depression and PTSD symptoms. In terms of unhealthy dietary behaviors, eating snacks more frequently was associated with higher life satisfaction and self-rated health, and frequently drinking of soft drinks was associated with higher self-rated health. Having sugared tea or coffee had a U shaped association with happiness, a reverse U shaped association with self-rated health, and a reverse J shaped association with depression symptoms. Chocolate

or candy consumption also had a reverse J shaped association with depression symptoms. Westover and Marangell (26) found cross-national observational evidence for the relationship between sugar consumption and major depression in Asian countries. Some of these abovementioned findings were also found in the previous studies. For example, sugar consumption (sweets, soft drinks, and cakes) was associated with more happiness in school children in Kuwait (27).

Study limitations included that study results cannot be generalized to all university students in the study countries. The cross-sectional design does not explain if positive well-being promotes a healthier dietary behavior or healthier dietary patterns lead to more positive well-being.

5.1. Conclusions

Overall, the study found some evidence that healthier dietary behaviors were associated with higher psychological well-being and lower mental distress, suggesting that a diet intervention may be helpful in preventing or alleviating mental distress in this ASEAN university student population.

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Footnotes

Authors' Contribution: All authors (Karl Peltzer and Supa Pengpid) have participated in this work via analysis and interpretation of data and have contributed to writing, editing, reading, and approving the paper.

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Table 2. Adjusted Means of the Total Happiness and Life Satisfaction Scores by Dietary Behaviors

| Dietary behavior | Sample | | Happiness Mean ^a (95% CI) | Life satisfaction Mean ^a (95% CI) |
|--|--------|------|---|---|
| | No. | % | | |
| Meals | | | | |
| One or Two | 1347 | 40.2 | 13.15 (12.97, 13.33) | 3.89 (3.85, 3.93) |
| Three | 1753 | 52.3 | 13.10 (12.95, 13.25) | 3.93 (3.89, 3.97) |
| Four or more | 249 | 7.4 | 13.29 (12.88, 13.69) | 3.85 (3.75, 3.95) |
| Eating breakfast | | | | |
| Rarely or never | 441 | 13.2 | 13.02 (12.69, 13.35) | 3.80 (3.73, 3.88) |
| Sometimes | 1405 | 41.9 | 13.18 (13.00, 13.36) | 3.92 (3.88, 3.96) |
| Almost every day | 1506 | 44.9 | 13.12 (12.97, 13.27) | 3.93 (3.89, 3.97) ^d |
| Fruits | | | | |
| 0 | 375 | 11.2 | 12.94 (12.29, 13.45) | 3.71 (3.63, 3.80) |
| 1 | 1726 | 51.5 | 13.08 (12.93, 13.29) | 3.89 (3.85, 3.93) |
| 2 | 700 | 20.9 | 13.12 (12.68, 13.06) | 3.97 (3.91, 4.03) |
| 3 | 352 | 10.5 | 13.23 (12.85, 13.61) | 4.00 (3.91, 4.09) ^b |
| 4 or more | 197 | 5.9 | 13.10 (12.64, 13.51) | 3.91 (3.79, 4.03) |
| Vegetables | | | | |
| 0 | 100 | 3.0 | 12.87 (12.29, 13.45) | 3.84 (3.67, 4.00) |
| 1 | 1274 | 38.0 | 13.11 (12.93, 13.29) | 3.90 (3.85, 3.95) |
| 2 | 1036 | 30.9 | 12.87 (12.68, 13.06) | 3.85 (3.80, 3.90) |
| 3 | 580 | 17.3 | 13.33 (13.05, 13.60) ^d | 3.93 (3.86, 4.00) |
| 4 or more | 362 | 10.8 | 13.31 (12.90, 13.63) | 3.94 (3.85, 4.02) |
| Avoid fat, cholesterol | | | | |
| No | 2010 | 60.3 | 12.98 (12.95, 13.12) | 3.88 (3.84, 3.94) |
| Yes | 1324 | 39.7 | 13.05 (12.88, 13.22) | 3.94 (3.90, 3.99) ^d |
| Foods high in fiber | | | | |
| No | 1650 | 49.4 | 12.70 (12.55, 12.84) | 3.89 (3.85, 3.93) |
| Yes | 1692 | 50.6 | 13.35 (13.20, 13.51) ^b | 3.92 (3.89, 3.96) |
| Snacks | | | | |
| 0 | 387 | 11.8 | 13.03 (12.75, 13.31) | 3.79 (3.71, 3.87) |
| 1 | 1257 | 38.5 | 13.28 (13.11, 13.45) | 3.82 (3.87, 3.96) |
| 2 | 991 | 30.3 | 13.17 (12.97, 13.38) | 3.93 (3.88, 3.98) |
| 3 | 391 | 12.0 | 12.84 (12.46, 13.21) | 3.89 (3.81, 3.97) |
| 4 or more | 243 | 7.4 | 13.70 (12.66, 13.74) | 4.03 (3.93, 4.14) ^c |
| Fast food in the past 7 days | | | | |
| 0 days | 1487 | 44.5 | 13.28 (13.12, 13.44) | 3.91 (3.87, 3.95) |
| 1 day | 952 | 28.5 | 13.33 (13.12, 13.54) ^b | 3.92 (3.87, 3.97) |
| 2 - 7 days | 905 | 27.1 | 12.61 (12.39, 12.83) | 3.89 (3.84, 3.95) |
| Soft drinks in the past 30 days | | | | |
| < 1 time/day | 681 | 20.3 | 13.33 (13.11, 13.55) ^b | 3.96 (3.92, 4.01) |

| | | | | |
|------------------------------|------|------|-----------------------------------|--------------------------------|
| 1 time/day | 1500 | 44.7 | 13.33 (13.18, 13.49) | 3.85 (3.81, 3.89) ^b |
| 2 or more times/day | 1172 | 35.0 | 12.52 (12.29, 12.75) | 3.93 (3.57, 3.99) |
| Chocolate, candy | | | | |
| Rarely or never | 511 | 15.2 | 13.14 (12.36, 13.43) | 3.84 (3.77, 3.91) |
| 1 - 2 or 3 - 6 times/week | 1416 | 42.2 | 13.03 (12.87, 13.18) | 3.91 (3.87, 3.95) |
| Once or more than once a day | 1430 | 42.6 | 13.24 (13.06, 13.41) | 3.93 (3.89, 3.97) |
| Sugared coffee, tea | | | | |
| Rarely or never | 619 | 18.5 | 13.11 (12.86, 13.35) | 3.92 (3.85, 3.98) |
| 1 - 2 or 3 - 6 times/week | 1273 | 37.9 | 12.78 (12.61, 12.95) ^c | 3.90 (3.85, 3.94) |
| Once or more than once a day | 1463 | 43.6 | 13.17 (13.01, 13.32) | 3.91 (3.87, 3.95) |
| Salt | | | | |
| Never | 523 | 15.7 | 12.69 (12.37, 13.01) | 3.83 (3.76, 3.90) |
| Very occasionally | 330 | 9.9 | 12.87 (12.56, 13.18) | 3.85 (3.76, 3.94) |
| Sometimes | 1200 | 36.0 | 13.25 (13.06, 13.43) ^d | 3.97 (3.93, 4.02) ^c |
| Usually | 1284 | 38.4 | 13.02 (12.86, 13.19) | 3.90 (3.85, 3.94) |
| Meat | | | | |
| Never | 51 | 1.5 | 12.98 (12.20, 13.17) | 3.86 (3.64, 4.08) |
| < 1 week | 136 | 4.1 | 12.86 (12.35, 13.37) | 3.82 (3.68, 3.96) |
| 1 week | 325 | 9.8 | 14.22 (13.89, 14.55) ^b | 3.92 (3.83, 4.01) |
| Every 2 - 3 days | 791 | 23.7 | 13.47 (13.24, 13.71) | 3.93 (3.88, 3.98) |
| At least once a day | 2029 | 60.9 | 12.85 (12.71, 12.99) | 3.90 (3.86, 3.94) |

^aMean adjusted for age, sex, subjective socioeconomic status, country, BMI, physical activity.

^bP < 0.001.

^cP < 0.01.

^dP < 0.5.

Table 3. Adjusted Means of the Total Self-Rated Health, Depression, and PTSD Scores by Dietary Behaviors

| Dietary Behavior | Self-Rated Health Status | Depression Symptoms | PTSD Symptoms |
|--|--------------------------------|-----------------------------------|--------------------------------|
| | Mean ^a (95% CI) | Mean ^a (95% CI) | Mean ^a (95% CI) |
| Meals | | | |
| One or Two | 2.98 (2.93, 3.02) | 19.58 (19.38, 19.78) | 2.07 (1.96, 2.17) |
| Three | 2.96 (2.93, 3.00) | 19.32 (19.14, 19.49) | 1.93 (1.83, 2.03) |
| Four or more | 2.97 (2.86, 3.07) | 19.21 (18.74, 19.68) | 2.09 (1.83, 2.34) |
| Eating breakfast | | | |
| Rarely or never | 2.92 (2.84, 2.99) | 20.01 (19.66, 20.36) ^b | 2.30 (2.11, 2.49) ^b |
| Sometimes | 2.97 (2.93, 3.01) | 19.74 (19.55, 19.94) | 2.14 (2.04, 2.25) |
| Almost every day | 2.99 (2.94, 3.03) | 18.92 (18.73, 19.11) | 1.76 (1.66, 1.86) |
| Fruits | | | |
| 0 | 2.87 (2.79, 2.96) | 19.91 (19.51, 20.31) ^d | 1.89 (1.67, 2.11) |
| 1 | 2.97 (2.93, 3.01) | 19.22 (19.04, 19.41) | 1.95 (1.85, 2.05) |
| 2 | 3.02 (2.96, 3.08) | 19.42 (19.13, 19.71) | 2.07 (1.92, 2.23) |
| 3 | 3.03 (2.94, 3.12) | 19.67 (19.26, 20.08) | 2.00 (1.78, 2.22) |
| 4 or more | 2.96 (2.85, 3.08) | 19.25 (18.73, 19.82) | 2.15 (1.65, 2.45) |
| Vegetables | | | |
| 0 | 2.86 (2.70, 3.03) | 19.39 (18.62, 20.66) | 2.16 (1.75, 2.57) |
| 1 | 2.98 (2.93, 3.03) | 19.36 (19.14, 19.58) | 1.93 (1.81, 2.05) |
| 2 | 2.96 (2.90, 3.01) | 19.38 (19.14, 19.62) | 2.07 (1.94, 2.20) |
| 3 | 3.00 (2.93, 3.07) | 19.42 (19.10, 19.74) | 1.91 (1.74, 2.08) |
| 4 or more | 2.98 (2.89, 3.07) | 19.54 (19.13, 19.95) | 2.00 (1.77, 2.22) |
| Avoid fat, cholesterol | | | |
| No | 2.94 (2.91, 2.98) | 19.41 (19.24, 19.57) | 2.01 (1.82, 2.10) |
| Yes | 3.01 (2.97, 3.06) ^d | 19.40 (19.20, 19.60) | 2.00 (1.89, 2.11) |
| Foods high in fiber | | | |
| No | 2.95 (2.91, 2.99) | 19.25 (19.07, 19.43) | 1.88 (1.78, 1.98) |
| Yes | 2.99 (2.96, 3.03) | 19.55 (19.37, 19.73) ^d | 2.11 (2.02, 2.21) ^b |
| Snacks | | | |
| 0 | 2.88 (2.80, 2.96) | 19.68 (19.30, 20.06) | 2.05 (1.85, 2.26) |
| 1 | 2.95 (2.91, 3.00) | 19.27 (19.06, 19.47) | 1.90 (1.85, 2.07) |
| 2 | 2.96 (2.91, 3.01) | 19.38 (19.15, 19.62) | 1.97 (1.84, 2.09) |
| 3 | 3.04 (2.96, 3.12) | 19.75 (19.37, 20.12) | 2.21 (2.00, 2.41) |
| 4 or more | 3.11 (3.01, 3.21) ^c | 20.11 (19.64, 20.59) ^c | 2.07 (1.81, 2.33) |
| Fast food in the past 7 days | | | |
| 0 days | 2.93 (2.89, 2.97) | 19.37 (19.18, 19.57) | 2.03 (1.90, 2.17) |
| 1 day | 3.00 (2.94, 3.05) | 19.35 (19.11, 19.59) | 1.86 (1.73, 1.99) ^d |
| 2 - 7 days | 3.00 (2.95, 3.06) | 19.54 (19.29, 19.79) | 2.07 (1.96, 2.17) |
| Soft drinks in the past 30 days | | | |
| < 1 time/day | 2.96 (2.90, 3.02) | 19.37 (19.09, 19.65) | 1.94 (1.79, 2.10) |

| | | | |
|------------------------------|--------------------------------|-----------------------------------|-------------------|
| 1 time/day | 2.92 (2.88, 2.97) | 19.41 (19.22, 19.60) | 2.06 (1.96, 2.17) |
| 2 or more times/day | 3.04 (2.99, 3.09) ^c | 19.45 (19.23, 19.66) | 1.94 (1.82, 2.06) |
| Chocolate, candy | | | |
| Rarely or never | 2.93 (2.86, 3.00) | 19.76 (19.44, 20.09) ^b | 2.16 (1.98, 2.33) |
| 1 - 2 or 3 - 6 times/week | 2.98 (2.94, 3.02) | 19.55 (19.35, 19.75) | 1.95 (1.85, 2.06) |
| Once or more than once a day | 2.97 (2.93, 3.01) | 19.15 (18.96, 19.35) | 1.98 (1.87, 2.09) |
| Sugared coffee, tea | | | |
| Rarely or never | 2.99 (2.93, 3.05) | 19.72 (19.43, 20.02) ^c | 1.93 (1.77, 2.09) |
| 1 - 2 or 3 - 6 times/week | 3.02 (2.98, 3.07) ^c | 19.53 (19.32, 19.74) | 1.97 (1.81, 2.09) |
| Once or more than once a day | 2.92 (2.88, 2.96) | 19.19 (18.99, 19.58) | 2.04 (1.94, 2.15) |
| Salt | | | |
| Never | 3.03 (2.95, 3.10) | 19.51 (19.18, 19.85) | 2.16 (1.98, 2.34) |
| Very occasionally | 2.96 (2.88, 3.05) | 19.72 (19.31, 20.13) | 2.00 (1.78, 2.22) |
| Sometimes | 2.95 (2.91, 3.00) | 19.51 (19.30, 19.73) | 2.01 (1.90, 2.13) |
| Usually | 2.97 (2.92, 3.02) | 19.23 (19.01, 19.45) | 1.92 (1.80, 2.04) |
| Meat | | | |
| Never | 3.15 (2.93, 3.37) | 20.29 (19.26, 21.33) | 2.04 (1.48, 2.60) |
| < 1 week | 2.98 (2.84, 3.11) | 19.15 (18.52, 19.79) ^c | 2.03 (1.68, 2.37) |
| 1 week | 3.04 (2.96, 3.13) | 19.22 (18.81, 19.63) | 1.90 (1.07, 2.12) |
| Every 2 - 3 days | 2.98 (2.92, 3.03) | 19.78 (19.52, 20.04) | 2.13 (1.99, 2.27) |
| At least once a day | 2.95 (2.91, 2.98) | 19.31 (19.14, 19.47) | 1.96 (1.87, 2.05) |

^aMean adjusted for age, sex, subjective socioeconomic status, country, BMI, and physical activity.

^bP < 0.001.

^cP < 0.01.

^dP < 0.5.