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Is there a relationship between chocolate consumption and symptoms of depression? A cross-sectional survey of 13,626 US adults

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Abstract

Objective: To examine associations between chocolate consumption and depressive symptoms in a large, representative sample of US adults.

Methods: The data were from 13,626 adults (≥20 years) participating in the National Health and Nutrition Examination Survey between 2007–08 and 2013–14. Daily chocolate consumption was derived from two 24-hr dietary recalls. Depressive symptoms were assessed using the Patient Health Questionnaire (PHQ-9), with scores ≥10 indicating the presence of clinically relevant symptoms. We used multivariable logistic regression to test associations of chocolate consumption (no chocolate, non-dark chocolate, dark chocolate) and amount of chocolate consumption (grams/day, in quartiles) with clinically relevant depressive symptoms. Adults with diabetes were excluded and models controlled for relevant sociodemographic, lifestyle, health-related, and dietary covariates.

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Results: Overall, 11.1% of the population reported any chocolate consumption, with 1.4% reporting dark chocolate consumption. Although non-dark chocolate consumption was not significantly associated with clinically relevant depressive symptoms, significantly lower odds of clinically relevant depressive symptoms (OR = 0.30, 95%CI 0.21–0.72) were observed among those who reported consuming dark chocolate. Analyses stratified by the amount of chocolate consumption showed participants reporting chocolate consumption in the highest quartile (104–454 g/day) had 57% lower odds of depressive symptoms than those who reported no chocolate consumption (OR = 0.43, 95%CI 0.19–0.96) after adjusting for dark chocolate consumption.

Conclusions: These results provide some evidence that consumption of chocolate, particularly dark chocolate, may be associated with reduced odds of clinically relevant depressive symptoms. Further research capturing long-term chocolate consumption and using a longitudinal design are required to confirm these findings and clarify the direction of causation.

KEYWORDS

chocolate, dark chocolate, depressive symptoms, epidemiology, NHANES

1 | INTRODUCTION

Depression is a serious, common, and recurring disorder that currently affects more than 300 million people worldwide (World Health Organization, 2018). It is the leading cause of disability and the fourth leading cause of global disease burden (Ustun, Ayuso-Mateos, Chatterji, Mathers, & Murray, 2004). Two main treatment options for depression have been shown to be effective in reducing symptoms: antidepressant medications and short-term psychotherapies, such as cognitive-behavioral therapy, interpersonal psychotherapy, or problem-solving therapy (Mynors-Wallis, Gath, Day, & Baker, 2000; Schulberg et al., 1996; Ward et al., 2000). Because of the limited availability of psychotherapy services, antidepressants are generally the most commonly prescribed treatment for depression in primary care (van Marwijk, Bijl, Ader, & de Haan, 2001). However, patient adherence is relatively low, with as many as half of patients prescribed these medications discontinuing their use within 6 weeks of starting treatment (Lawrenson, Tyrer, Newson, & Farmer, 2000).

The potential to control depressive symptoms via lifestyle changes may provide an attractive option to patients for whom conventional treatments are not an effective option and individuals with subclinical depressive symptoms who are not eligible for formal treatment. Benefits of physical activity are well documented (Schuch et al., 2018; Stubbs et al., 2018; Teychenne, Ball, & Salmon, 2008). In addition, a growing body of evidence has highlighted the influence of dietary factors on symptoms of depression (Molendijk, Molero, Ortuno Sanchez-Pedreno, Van der Does, & Angel Martinez-Gonzalez, 2018). One commonly consumed foodstuff postulated to have mood-enhancing properties is chocolate. Several mechanisms for a relationship between chocolate and mood have been proposed, including chocolate's orosensory properties, psychoactive ingredients, and activation of neural reward pathways (Bruinsma & Taren, 1999; Hurst, Martin, & Zoumas, 1982; Parker, Parker, & Brotchie, 2006). However, there is a lack of high-quality scientific evidence to support such an association. Only a small number of studies have analyzed associations between chocolate consumption and depressive symptoms, with mixed findings. A 2013 systematic review of experimental research on the effects of chocolate or its components on mood identified eight small studies ($n \leq 113$), of which five reported either an improvement in mood state or attenuation of negative mood (Scholey & Owen, 2013). A recent umbrella review on chocolate consumption and all health outcomes concluded on the basis of existing evidence that chocolate consumption has no impact on depression (Veronese et al., 2019). A cross-sectional survey of 931 adults without diabetes or known coronary artery disease found higher depressive symptom scores were associated with greater chocolate consumption in both men and women (Rose, Koperski, & Golomb, 2010). Likewise, another study of 362 women observed a positive correlation between reported chocolate consumption and scores on a measure of psychiatric symptomology (Barkeling et al., 2002). However, previous studies have not adequately controlled for variables that may potentially confound the association between chocolate and depression, such as socioeconomic status.

Moreover, previous studies have not examined the association with depression according to the type of chocolate consumed. There is a large body of literature demonstrating a positive association between dark chocolate consumption and physical health outcomes (Mursu et al., 2004; Tokede, Gaziano, & Djousse, 2011; Vlachopoulos et al., 2005). This beneficial effect of dark chocolate is likely owing to flavonoids that have antioxidant properties and improve

inflammatory profiles (Minihane et al., 2015). Flavonoids have also been shown to have a positive influence on episodic memory and cognitive decline (Minihane et al., 2015). It may, therefore, be that dark chocolate (rich in flavonoids) has a positive effect on mental health, including depression, whereas milk chocolate (lower in flavonoids) does not. However, to date, the association between the consumption of dark chocolate and depression has not been investigated.

The present study, therefore, aimed to examine the relationship between chocolate consumption and symptoms of depression in a large, nationally-representative sample of adults living in the US, with adjustment for a wide range of potential confounders. Specifically, we were interested in: (a) the association between chocolate consumption (any dark chocolate, chocolate but not dark chocolate, none) and depressive symptoms among all adults, and (b) the association between the amount of chocolate consumption and depressive symptoms.

2 | MATERIALS AND METHODS

2.1 | Study population

The National Health and Nutrition Examination Survey (NHANES), described in detail elsewhere (Curtin et al., 2012; Curtin et al., 2013), was designed to provide cross-sectional estimates of the prevalence of health, nutrition, and potential risk factors among the civilian noninstitutionalized US population (Centers for Disease Control & Prevention, 2018). Since 1999, NHANES has surveyed a nationally representative, complex, stratified, multistage probability sample of the US population continuously in 2-year cycles, with different participants included in each wave. The assessment methods include a household interview and a physical examination in a mobile examination center (MEC). For the present analyses, we included participants over five cycles from 2007–08 to 2013–14 with available data on chocolate consumption from two 24-hr dietary recalls. We restricted our study sample to adults aged ≥20 years because the assessment of depressive symptoms was only done in this age range.

2.2 | Measures

2.2.1 | Exposure: Chocolate consumption

A key component of NHANES is a dietary assessment. In brief, NHANES participants are asked to complete two 24-hr recalls of dietary intake using the USDA's Automated Multiple-Pass method (Ahluwalia, Dwyer, Terry, Moshfegh, & Johnson, 2016). For the cycles used in the present analyses, the first 24-hr recall was administered in person by a trained dietary interviewer using a standardized protocol during the physical examination in a mobile examination center. The second 24-hr recall was administered via telephone between 3 and 10 days after the first recall. Nutrient intakes were calculated on the basis of food intake using a revised nutrient database that converts the intake of food items to nutrients for each individual. Daily chocolate consumption (overall and dark chocolate [≥45% cocoa solids] specifically) was calculated in grams using the average of the two 24-hr recalls, with implausibly high intakes excluded by removing observations above the 99th centile. The present analyses focus on two variables derived from this measure of chocolate consumption. The first was a three-level categorical measure of chocolate consumption (none, chocolate but not dark chocolate, any dark chocolate). The second was a five-level measure of the amount of chocolate consumed (any type) in gram/day. Individuals who reported no chocolate consumption were coded 0, and those who reported any chocolate consumption were grouped into quartiles, coded 1 through 4 from the lowest to highest chocolate consumption.

2.2.2 | Outcome: Depressive symptoms

Depressive symptoms were assessed using the Patient Health Questionnaire (PHQ-9), a valid 9-item depression screener that asks about the frequency of symptoms of depression over the past 2 weeks (Kroenke, Spitzer, & Williams, 2001; Mitchell, Yadegarfar, Gill, & Stubbs, 2016). Each item was scored on a 0–3 scale, with a total score ranging from 0–27. On the basis of these scores, depressive symptoms can be categorized as "none or minimum" (0–4), "mild" (5–9), "moderate" (10–14), "moderately severe" (15–19), and "severe" (20–27). For the present analyses, the data were dichotomized to distinguish between participants who scored 9 or less and those who scored ≥10 or more; the latter indicating clinically relevant depression. This cut-off has previously been shown to have a sensitivity of 88% and a specificity of 88% for major depression (Kroenke et al., 2001; Manea, Gilbody, & McMillan, 2012; Mitchell et al., 2016).

2.2.3 | Covariates

Total energy intake and total sugar intake were derived from the mean of the two 24-hr dietary recalls, and categorized into quartiles. Alcohol intake was derived from two 24-hr recalls and dichotomized to no (zero intake) and yes (any intake).

Weight and height were measured during the physical examination in a mobile examination center or in the participant's home, following standard procedures. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters and categorized as underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), or obese (≥30 kg/m^2). For analytic purposes, we excluded those with an underweight BMI because of potential underlying health conditions.

Self-reported sociodemographic characteristics included age, marital status (collapsed to living alone [widowed, divorced, separated, never married] and living with someone [married, living with partner]), sex (men and women), race (Non-Hispanic White, Non-Hispanic Black, Hispanic, other [other than Non-Hispanic White, Non-Hispanic Black, Hispanic, including multi-racial]), education (collapsed to below high school [less than 9th grade, 9–11th grade],

high school [high school graduate/GED or equivalent], above high school [some college or AA degree, college graduate or above]) and annual household income (15 categories of annual household income levels collapsed to <$25,000, $25,000–$74,999, and ≥$75,000).

Lifestyle characteristics included leisure-time physical activity and smoking status. Participants reported the number of days and minutes spent in moderate and vigorous recreational activities in a typical week. We summarized the total number of minutes for both activities and classified participants as inactive (zero moderate-to-vigorous physical activity) or active (any moderate-to-vigorous physical activity) on the basis of physical activity guidelines (U.S. Department of Health & Human Services, 2018). Smoking status was classified into: never smokers (have never smoked 100 cigarettes and do not smoke now), former smokers (have smoked 100 cigarettes in a lifetime and do not smoke now), and current smokers (have smoked 100 cigarettes in lifetime and smoke now).

Information on chronic conditions that were considered suspected correlates were extracted, including self-reported doctors' diagnoses (by answering the question "Has a doctor or other health professional ever told you that you had…" for each condition) of cardiovascular disease, arthritis, and cancer. Participants who reported diabetes mellitus were excluded from the analyses because of potential confounding by increased prevalence of depression (Roy & Lloyd, 2012) and the likelihood of dietary restrictions that prohibit chocolate consumption.

2.3 | Statistical analyses

All statistical analyses were performed using STATA version 14.0 (STATA Corp., College Station, TX). Survey analysis procedures were used to account for the sample weights, stratification, and clustering of the complex sampling design to ensure nationally representative estimates (Curtin et al., 2012). Descriptive characteristics were analyzed by summarizing weighted means and standard errors for continuous variables and weighted proportions for categorical variables by chocolate consumption status (none, non-dark chocolate, dark chocolate) as well as by quartiles of chocolate consumption.

Three multivariable logistic regression models were constructed to evaluate the association of chocolate consumption with clinically relevant depressive symptoms. First, we estimated the independent association of chocolate consumption (none, non-dark chocolate, and dark chocolate) with clinically relevant depressive symptoms in the entire sample. Secondly, we tested whether the amount of chocolate consumption (zero for non-chocolate consumers, and in quartiles among chocolate consumers) was independently associated with clinically relevant depressive symptoms, with and without adjustment for dark chocolate consumption (yes/no). It was not possible to analyze the association with the amount of dark chocolate consumption specifically due to the small number of participants reporting any dark chocolate consumption. All models were adjusted for sociodemographic factors (age, sex, marital status, education level, annual household income), weight status, lifestyle factors (leisure-time physical activity, smoking status, alcohol intake, total energy intake), and chronic conditions. We constructed models with and without total sugar intake to assess whether the adjustment for sugar consumption may lead to over-adjustment, as there might be a potential overlap between chocolate consumption and sugar intake. Diagnostic tests were performed to evaluate the degree of multicollinearity in each model. We considered p values < .05 to be statistically significant.

3 | RESULTS

A total of 20,125 men and women aged ≥20 years provided the data on chocolate consumption and depressive symptoms. We excluded those who were underweight (n = 304), and those with diabetes (n = 2518). A further 3,677 participants were excluded because of missing covariates, leaving a total of 13,626 in the final analyses (mean age 46.5 years, 47.8% male). The individuals we excluded had a similar prevalence of clinically relevant depressive symptoms to the analyzed sample (Chi-square p = .18), but there were more chocolate consumers in the analyzed sample (11.1% vs. 7.0%, Chi-square p < .001).

Of our analyzed sample, 1,332 (11.1%) adults reported any chocolate consumption in their two 24-hr dietary recalls, of whom 148 (12.1%) reported any dark chocolate consumption. Sample characteristics in relation to chocolate consumption are summarized in Table 1 (for sample characteristics in relation to quartiles of chocolate consumption see Table S1). Those who reported any chocolate consumption were slightly older on average than those who did not report chocolate consumption. They were more likely to be Non-Hispanic White and have a higher household income and level of education, and were less likely to smoke or have a BMI in the obese range. Average daily intakes of total energy and sugar were higher among adults who were non-dark chocolate consumers. In addition, chocolate consumption was not significantly associated with alcohol drinking nor chronic conditions in our study population.

After adjustment for covariates, no association was observed between non-dark chocolate consumption and clinically relevant depressive symptoms (Table 2). However, individuals who reported any dark chocolate consumption had 70% lower odds of reporting clinically relevant depressive symptoms than those who did not report any chocolate consumption (OR = 0.30, 95% CI 0.21–0.72). In models including the amount of chocolate consumption, a significant association between the highest quartile of total chocolate consumption and clinically relevant depressive symptoms (OR = 0.42, 95% CI: 0.19–0.92). This association remained significant after adjusting for dark chocolate consumption (yes/no) (OR = 0.43, 95% CI: 0.19–0.96; Table 2). The results were similar with and without the adjustment for sugar intake. Hence, the adjustment for sugar intake is unlikely to lead to an over-adjustment (Table 2). No severe multicollinearity was observed, with variance inflation factors between 1.03 and 1.93, and tolerance between 0.5172 and 0.9754.

TABLE 1 Sociodemographic characteristics of US adults aged 20–80 years in the NHANES (2007–2014), by chocolate consumption status[a]

		Chocolate consumption			
		None (n = 12,294)	Non-dark chocolate (n = 1,184)	Dark chocolate (n = 148)	p value
Age (years)	mean (se)	46.2 (0.3)	47.8 (0.5)	57.3 (1.2)	< .001
Sex (men)	%	48.8	39.7	43.8	
Marital status (living with someone)	%	64.3	68.1	74.0	< .001
Race					< .001
Non-Hispanic White	%	70.5	80.2	86.7	
Non-Hispanic Black	%	10.6	4.4	3.0	
Hispanic	%	13.0	9.6	4.8	
Other	%	5.9	5.8	5.5	
Household income					< .001
≤$20000	%	20.6	15.7	11.0	
$20000–74999	%	42.1	38.7	34.4	
≥$75000	%	37.3	45.6	54.7	
Education					< .001
Less than High school	%	15.4	10.1	4.1	
High School	%	22.3	19.0	15.3	
Some college and above	%	62.4	70.9	80.6	
Smoking					< .001
Never smoker	%	55.6	61.5	64.1	
Former smoker	%	24.1	24.7	26.9	
Current smoker	%	20.3	13.8	9.0	
Alcohol drinking (yes)	%	36.1	36.9	46.3	.39
BMI (kg/m^2)					< .001
18.5–24.9	%	29.6	34.9	38.8	
25.0–29.9	%	35.2	39.2	32.9	
≥30	%	35.2	25.9	28.3	
Chronic conditions (yes)[b]	%	28.8	32.3	42.0	.004
Depressive symptoms (yes)[c]	%	7.6	6.2	1.5	.019
Total energy intake (kcal, day)	mean (se)	2115.6 (10.5)	2295.7 (35.7)	2122.6 (88.2)	.014
Total sugar intake (gram, day)	mean (se)	113.2 (0.9)	127.6 (3.0)	120.2 (6.4)	< .001
Total chocolate intake (gram, day)	mean (se)	n.a	91.8 (2.7)	77.7 (5.8)	
Total dark chocolate intake (gram, day)	mean (se)	n.a	n.a	11.7 (1.0)	

Abbreviation: NHANES, the National Health and Nutrition Examination Survey.
[a]All estimates are weighted to be nationally representative.
[b]Depressive symptoms measured using Patient Health Questionnaire (PHQ-9): None or minimum to mild (0–9), moderate to severe (10–27).
[c]Chronic conditions include cardiovascular disease, arthritis, and cancer.

4 | DISCUSSION

In a large, representative sample of US adults, individuals who reported any consumption of dark chocolate were less likely to report clinically relevant depressive symptoms, but no such association was observed for non-dark chocolate. However, we also observed a significant association with the amount of chocolate consumed, with individuals in the upper quintile of chocolate consumption (calculated among chocolate consumers) significantly less likely to report clinically relevant depressive symptoms than those who reported no chocolate consumption, even after adjustment for type of chocolate. These associations were evident after adjustment for age, marital status, level of education, annual household income, weight status, chronic conditions, leisure-time physical activity, smoking status, alcohol intake, total energy intake, and total sugar intake.

The present results are in line with the majority of experimental studies, which have shown benefits of chocolate consumption for mood, at least in the short-term (Scholey & Owen, 2013). However, they are inconsistent with previous surveys that have found positive

TABLE 2 Associations of chocolate consumption with clinically relevant depressive symptoms among adults aged 20–80 years (n = 13,626) in NHANES (2007–2014)[a]

	Unadjusted OR(95% CI)	Multivariable-adjusted[b] OR(95% CI)	Multivariable-adjusted[c] OR(95% CI)	Multivariable-adjusted[d] OR(95% CI)
Overall chocolate[b]				
None	Reference	Reference	Reference	
Non-dark chocolate	0.80 (0.59 to 1.08)	0.95 (0.70 to 1.28)	0.94 (0.69 to 1.27)	
Dark chocolate	0.19 (0.07 to 0.48)	0.30 (0.12 to 0.72)	0.30 (0.12 to 0.72)	
Daily chocolate consumption[b]				
None	Reference	Reference	Reference	Reference
1st quartile (4.1–35.0 grams)	0.95 (0.53 to 1.71)	1.03 (0.57 to 1.87)	1.03 (0.57 to 1.86)	1.03 (0.57 to 1.87)
2nd quartile (37.0–95.1 grams)	0.45 (0.24 to 0.84)	0.56 (0.30 to 1.03)	0.55 (0.30 to 1.02)	0.64 (0.33 to 1.22)
3rd quartile (100–100 grams)	0.98 (0.61 to 1.57)	1.28 (0.80 to 2.03)	1.27 (0.79 to 2.02)	1.29 (0.80 to 2.07)
4th quartile (104–454 grams)	0.34 (0.16 to 0.73)	0.42 (0.19 to 0.93)	0.42 (0.19 to 0.92)	0.43 (0.19 to 0.96)
P for trend[e]	0.015	0.224	0.211	0.325

Abbreviation: NHANES, the National Health and Nutrition Examination Survey.

[a]Depressive symptoms measured using Patient Health Questionnaire (PHQ-9): None or minimum to mild (0–9), moderate to severe (10–27).

[b]Adjusted for age, sex, BMI category (normal weight, overweight, obese), race (non-Hispanic white, non-Hispanic black, Hispanic, other), education (below high school, high school, high school and higher), household annual income (<$20000, $20000–74999, $75000, and higher), physical activity (inactive, any activity), smoking status (never smoker, former smoker, current smoker), energy intake in quartiles, sugar intake in quartiles, alcohol consumption (yes/no), and chronic conditions including cardiovascular disease, arthritis and cancer (yes/no).

[c]Additionally adjusted for daily sugar intake (grams/day).

[d]Additionally adjusted for dark chocolate consumption (yes/no).

[e]P for trend was calculated by modeling the median value of chocolate consumption in each quartile as a continuous variable.

associations between chocolate consumption and depressive symptoms (Barkeling et al., 2002; Rose et al., 2010). The discrepant results may be attributable to the adjustment in the present analyses for a wide range of covariates accounting for potential confounding. Alternatively, the representative sample here may differ from those of previous studies, which focused on adults without specific medical conditions (Rose et al., 2010) or women aged 34–64 years (Barkeling et al., 2002).

There are a number of potential mechanisms through which chocolate consumption could prevent the onset of, or cause a reduction in, depressive symptoms. Chocolate contains a number of psychoactive ingredients, including two analogs of anandamine (which produce effects similar to the cannabinoid responsible for euphoria from cannabis) and several endogenous biogenic amines (Bruinsma & Taren, 1999; Hurst et al., 1982; Parker et al., 2006). Notably, the latter include phenylethylamine, a neuromodulator believed to be important for mood regulation and implicated in the pathogenesis of depression (Bruinsma & Taren, 1999; Sabelli & Javaid, 1995). Chocolate consumption, as a pleasurable experience, may interact with several neurotransmitter systems implicated in reward pathways and mood regulation (e.g. dopamine, serotonin, and endorphins) (Bruinsma & Taren, 1999; Parker et al., 2006). Experimental evidence suggests that improvements in mood after chocolate consumption is likely attributable to the chocolate's palatability (Macht & Dettmer, 2006; Macht & Mueller, 2007). In a study that compared effects of eating palatable chocolate, unpalatable chocolate, and nothing on experimentally-induced negative mood states, an immediate benefit was only seen after consumption of palatable chocolate, with no difference between unpalatable chocolate and nothing (Macht & Mueller, 2007). However, this would not explain why the associations observed in the present study were more pronounced for dark chocolate than for all chocolate. It is possible that the rich concentration of flavonoids in the dark chocolate may be important. Indeed, flavonoids have been shown to improve in inflammatory profiles and unfavorable inflammatory profiles have been shown to play a role in the onset of depression (Penninx, Milaneschi, Lamers, & Vogelzangs, 2013). Further research is required to elucidate the nature of the relationship between chocolate consumption and depressive symptoms.

Strengths of the present study include the large, nationally-representative sample, detailed dietary assessment, and adjustment for a wide range of relevant covariates. However, there were also several limitations. First, the cross-sectional design means we were unable to determine whether chocolate consumption protected against the onset of depressive symptoms. An alternative explanation may be depressive symptoms make people less inclined to eat chocolate. However, previous research has suggested that almost half (44.9%) of people who have experienced depressive episodes lasting 2 weeks or longer that required treatment report craving chocolate when depressed, with many believing that chocolate helps to settle feelings of anxiety and irritability (Parker & Crawford, 2007). Secondly, chocolate consumption was based on the average of two 24-hr dietary recalls. Although dietary recalls are generally considered to provide a more robust measure of nutrient consumption than food frequency questionnaires, which ask participants to report how often they eat different types of foods, the measure of chocolate consumption in the present study may not accurately reflect average intake over a prolonged period because chocolate is not a product that is typically consumed every day. As such, the potential for misclassification of chocolate consumption is high. There is a need to replicate our findings using other measures of chocolate consumption that capture usual intake over the longer term. Thirdly, the group of dark chocolate consumers in our analyzed sample was small with low consumption (less than 1.1% of the total population with an average of 11.7 grams of daily dark chocolate intake) and differed from the rest of the population on a number of key characteristics. Nonetheless, the fact we observed a significant association between dark chocolate consumption despite the small sample and low average consumption attests to the strength of this finding. Although we did adjust for a number of covariates, it is possible that we lacked information on some characteristics of dark chocolate consumers that could have confounded the associations assessed. Thus, some caution should be taken when interpreting these results. Finally, although we adjusted for a wide range of potential confounders, there may be residual confounding by unmeasured variables. Studies using a randomized design to test the effect of chocolate consumption (in particular, dark chocolate) on mood over a prolonged period could provide further insight into the exact nature of the relationship between these variables.

In conclusion, the present results provide some evidence that consumption of chocolate, particularly dark chocolate, may be associated with reduced odds of clinically relevant depressive symptoms. Further research is required to clarify the direction of causation. Should a causal relationship demonstrating a protective effect of chocolate consumption on depressive symptoms be established, its biological mechanism needs to be elucidated to determine the type and amount of chocolate consumption for optimal depression prevention and management.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

The NHANES data that support the findings of this study are available online through https://wwwn.cdc.gov/nchs/nhanes/Default.aspx

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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