**Prevalence, Correlates and Misperception of Depression Symptoms in the United States, NHANES 2015-2018**

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**Abstract**

**Purpose**: To update the prevalence of depression in the US and identify whether misperception exists in depression assessed by self-report versus validated tools administered by trained professionals.

**Methods:** We extracted data on sociodemographic characteristics, lifestyle factors, medical conditions, self-reported depression, and depressive symptoms from National Health and Nutrition Examination Survey (NHANES) study 2015-2018.We calculated the weighted prevalence and 95% CI of self-reported depression and depressive symptoms assessed by a validated tool PHQ-9 (score≥10) respectively. Then, we performed multivariable logistic regressions to identify the sociodemographic and lifestyle correlates. Finally, we calculated the agreement between depressive symptoms and self-reported depressive feeling to examine possible misperception.

**Results:** The present analysis included a total of 10,257 adults (Weighted N= 215,964,374) aged 20 years and older. Prevalence of depressive symptoms (PHQ-9 score ≥10) were 8.0 % from 2015 to 2018 in the US. 19.7 % and 11.3 % adults reported feeling depressed at least once a month and at least once a week, respectively. Depressive experience was largely misperceived in the US (Kappa agreement=50.98%, Cohen’s Kappa=0.16, p<0.001). Particularly, an estimated 1.1 million US adults had depressive symptoms but never felt being depressed. Several consistent demographic and behavioral correlates were identified across the two measures, namely: age, sex, race/ethnicity, poverty and sitting time.

**Conclusions:** A high prevalence of depression was found, and misperception of depression exists among large US adult population. Our findings highlight an urgent need for health professionals to reduce the burden of depression with considering patients’ socioeconomic status and lifestyle factors.

**Keywords: Depression; Prevalence; Correlates; Misperception; PHQ-9**

**Background**

Depression (major depressive disorder or clinical depression) is a prevalent mood disorder in the US (Brody, Pratt, & Hughes, 2018). Each year, depression affects more than 16.1 million American adults, or about 6.7% of the U.S. population aged 18 and older (National Institute of Mental Health, 2019). This is of concern as depression has been found to be associated with many negative behavioral, physical, and psychological health outcomes such as an increased likelihood of smoking tobacco (Weinberger et al., 2017), illicit drug use (Manchikanti et al., 2007), and alcohol abuse (Buckner, Keough, & Schmidt, 2007), lower levels of physical activity and fitness (Cao et al., 2020; Rebar et al., 2015), and higher levels of obesity (Mannan, Mamun, Doi, & Clavarino, 2016), consequently, higher risk of cardiovascular disease and lower levels of quality of life (Penninx, 2017; Sivertsen, Bjørkløf, Engedal, Selbæk, & Helvik, 2015).

Owing to the high prevalence of depression and its negative consequence on behavior and health, it is important to ensure that: (1) the reporting of depression is accurate so that trends and prevalence can be monitored and risk factors/ correlates can be effectively identified; (2) individuals are able to accurately evaluate their levels of depression so that they can actively seek mental health service. However, a prominent barrier exists in practical settings in that depressive symptoms are typically measured on a continuum, while the diagnosis of depression is categorical (Paykel, 2002). Therefore, minor changes in case definition or in measuring instruments may yield major differences in prevalence estimates (Karlsson, Marttunen, Karlsson, Kaprio, & Hillevi, 2010).

In addition, a major complication in the measurement of depression, particularly, in epidemiological studies is that of self-report as opposed to a clinical assessment (Eaton, Neufeld, Chen, & Cai, 2000). Self-reported measures are often criticized given that their validity is highly dependent upon the respondents’ willingness and ability of making accurate judgement (Brenner & DeLamater, 2016). It is possible that two people are experiencing the same level of depression but they may perceive the level, or report it, to be significantly different. Consequently, it presents substantial limitations in prevalence estimates of depression, as well as identified correlates, which is likely to influence policy and practice that aims to reduce depression at the population-level (Sohail, Bailey, & Richie, 2014). It is therefore important to identify if misperception exists in the reporting of depression. To the best of our knowledge, no literature exists on the misperception of depression but it has been shown to exist in relation to other states, including tiredness and aggression (Akram, Ellis, Myachykov, & Barclay, 2016; Hall & Davidson, 1996), providing support for this hypothesis. If misperception does exist in relation to depression, then there maybe bias/ error in existing identified correlates and risk factors of this mood disorder. It is therefore also important to test whether correlates of depression differ by self-reported depression and validated tools administered by trained professionals.

Therefore, the present study aims to update the prevalence of depression in the US and identify whether misperception exists in depression by self-report versus validated tools administered by trained professionals.

**Method**

***Study population***

The National Health and Nutrition Examination Survey (NHANES) study was conducted by the US National Center for Health Statistics (NCHS), Center for Disease Control and Prevention (Curtin et al., 2012). Briefly, the NHANES study aimed to estimate the prevalence of health, nutrition, and potential risk factors through surveying a nationally representative, complex, stratified, clustered, multistage probability sample of the civilian non-institutionalized US population continuously in 2-year cycles since 1999. The study was approved by NCHS and received informed consent from all participants who finished an in-home interview and a physical examination in a mobile examination center. We extracted data on sociodemographic characteristics, measured weight and height, lifestyle behaviors, physical limitations, and depression symptoms from NHANES 2015-2016.

***Depressive symptoms***

Depressive symptoms were assessed using the Patient Health Questionnaire (PHQ-9), a valid 9-item depression screener asking about the frequency of depressive symptoms over the past 2 weeks, during the in-person interview conducted by a trained professional (Zimmerman, 2019). Each item was scored on a 0–3 scale. The total score of PHQ-9 ranged from 0 to 27, and were categorized as “none or minimum” (0–4), “mild” (5–9), “moderate” (10–14), “moderately severe” (15–19), and “severe” (20–27) for depression severity. Also, based on extensive research on the accuracy of PHQ-9, we defined the participants who scored 10 or more as having potentially clinically relevant depression (Kroenke, Spitzer, & Williams, 2001).The PHQ-9 is well-established validated tool with high accuracy for screening and detecting major depression and recommended in the clinical practice (Levis, Benedetti, Thombs, & Collaboration, 2019; Zimmerman, 2019).

***Self-reported frequency of struggles with mental disorders***

Information on self-reported depression were acquired from the disability questionnaire. Participants were asked, “How often do you feel depressed?” Response options included “Daily”, “Weekly”, “Monthly”, “A few times a year”, and “Never”. Two frequency cutoffs, monthly or higher vs. less than monthly and weekly or higher vs. less than weekly, were used in the present analysis. Moreover, participants were asked, “Do you take medication for depression”, respectively. Responses were categorized as “Yes” (use) and “No” (non-use) (National Health and Nutrition Examination Survey, 2017).

***Socio-demographic characteristics and lifestyle behaviors***

Self-reported sociodemographic characteristics included sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and others), family income-to-poverty ratio (<1.3 [lowest income], 1.3-<3.5, ≥3.5 [highest income]), and educational attainment (less than high school, high school, and above high school). Weight and height were measured during the physical examination at the mobile examination center, and body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared.16 Participants reported whether they engaged in recreational moderate and vigorous physical activities (MVPA) over the past 30 days. No vs. any MVPA at leisure-time was used to define inactive vs active participants. Smoking status was classified into never smokers (did not smoke 100 cigarettes and do not smoke now), former smokers (smoked 100 cigarettes in life and do not smoke now), or current smokers (smoked 100 cigarettes in life and smoke now) (Yang et al., 2019).

***Chronic conditions***

Six chronic conditions were included in the analyses: hypertension, high cholesterol, diabetes, heart disease, cancer and osteoarthritis (Grabovac et al., 2020). Participants with hypertension and high cholesterol were identified using self-reported and laboratory examinations. Hypertension was determined if they were told by a health professional that they had high blood pressure or hypertension, or the mean of at least 3 blood pressure measurements was 140 mm Hg or higher for systolic, or 90 mm Hg or higher for diastolic (Whelton et al., 2018). High blood cholesterol was determined by self-report of being told by a health professional, or if the measured total cholesterol level was 6.2 mmol/L (240 mg/dL) or higher (Roth et al., 2011). Participants were considered as having diabetes if they were told by a physician that they had diabetes or reported currently taking prescription medication to treat diabetes. Heart disease was defined based on participants’ self-report of being diagnosed with conditions such as congestive heart failure, angina, heart attack, or coronary heart disease. Cancer and osteoarthritis were identified based on self-reported questions on whether participant ever had such conditions (Roberts et al., 2020).

***Statistical Analyses***

Survey analysis procedures were used to account for the complex survey design to ensure nationally representative estimates. We calculated the weighted prevalence and 95% CI of self-reported depression and clinical depression, respectively. Then, we performed multivariable logistic regressions and reported odds ratios (ORs) to identify the sociodemographic and lifestyle correlates which included age, sex, race/ethnicity, family poverty ratio, education attainment, BMI, leisure time physical activity, sitting time, smoke status, chronic conditions, and taking medicine for depression.

In addition, we examined the agreement between depression severities and frequencies of self-reported depression using Cohen's Kappa and Person Chi-square test. Multiple datasets were aggregated using SAS, version 9.4 (SAS Institute, North Carolina, USA), and the analyses for estimating participant characteristics and multiple multivariable logistic regressions were done using Stata, version 15.1 (StataCorp, Texas, USA). All statistical tests were 2-sided and statistical significance was set at P < .05.

**Results**

A total of 10,257 individuals (Weighted N= 215,964,374) aged 20 years and older were included in the present analysis, including 5016 men and 5241 women (**Table 1**). Participants with missing covariates (5.5% for self-reported depression; 1.0% for PHQ-9) were excluded in the multivariable analyses.

***Self-reported Depression***

For self-reported depression, the estimated prevalence of feeling depressed at least monthly and feeling depressed at least weekly was 19.7 % (95% CI, 18.5% to 20.9%) and 11.3 (95% CI, 10.3 to 12.3), respectively. We observed that age was negatively associated with the prevalence of depressive feeling (monthly: OR 0.98 [95% CI, 0.97 to 0.98]; weekly: OR 0.99 [95% CI, 0.98 to 0.99]). Women were more likely to report depressive feeling than man (Monthly: 22.2% vs. 17.0%; Weekly: 12.7% vs. 9.8%). After adjusting for sociodemographic and lifestyle characteristics, Non-Hispanic White were more likely to report depressive feeling compared with Non-Hispanic Black and Hispanic. Also, self-reported depression was consistently more commonly reported among those with lower education levels, those with longer sitting time, those with lower family poverty ratio, those with stroke and those with high cholesterol (all p values <0.05). Moreover, 62.6% adults with self-reported depression was taking medicine for depression (OR 10.5; 95% CI, 8.33 to 13.2) (**Table 2-3**).

***Depressive symptoms (PHQ-9)***

The estimated prevalence for PHQ-9 scores ≥ 10 was 8.0% (95% CI, 7.3% to 8.7%) among US adults from 2015-2018. Age was negatively associated with the prevalence of depressive symptoms (OR 0.98; 95% CI, 0.97 to 0.99). Similar to the results from self-reported depression, Women had a higher prevalence of depressive symptoms than man (9.7% vs. 6.3%; OR 1.41 [95% CI, 1.10 to 1.83]). In addition, having depressive symptom was observed to be significantly associated with being non-Hispanic black (OR 0.78 [95% CI, 0.61 to 1.00]), having low family poverty ratio (p for trend < 0.001), low education attainment (p for trend=0.009), being physically inactive at leisure-time (OR 0.66 [95% CI, 0.50 to 0.87]), having longer sitting time (p for trend =0.006), having heart disease (OR 1.53; [95% CI, 1.07 to 2.17], and being diagnosed with diabetes (OR 1.43; [95% CI, 1.10 to 1.84]) After adjusting for sociodemographic and lifestyle characteristics. Also, 29.7% adults with depressive symptoms were taking the medicine for depression (**Table 2-3**).

***Misperception of Depression***

Depressive experience was largely misperceived in the US (Kappa agreement=50.98%), where adults either over- or underestimated their depressive symptoms (Cohen’s Kappa=0.16, p<0.001). Among those categorized in the “non-depression” group based on the PHQ-9 assessment (0-4), 55.7% self-reported never felt depressed; among the mildly depressed (PHQ-9: 5-9), 37.5% reported that they had felt depressed a few times a year; among moderately depressed individuals (PHQ-9: 10-14), 15.7% reported having felt depressed monthly; among moderately severe depressed individuals (PHQ-9: 15-19), 19.9% reported having experienced depression weekly and among severely depressed individuals (PHQ-9: 20-27), 68.4% reported having felt depressed daily. Particularly, an estimated 1.1 million US adults had depressive symptoms but never felt being depressed, whereas an estimated 1.3 million US adults had no depressive symptoms but felt being depressed daily (**Table 4**).

**Discussion**

In this large sample of US adults, the prevalence of PHQ-9 indicated severe depressive symptoms is considerable high, yet lower than half of the prevalence of self-reported depression. Furthermore, depressive experience was widely misperceived by US adults. Although some of the adults in the present sample underestimated their depressive symptoms, the majority overestimated when asked to self-assess it. Finally, consistent demographic and behavioral correlates (age, sex, race/ethnicity, poverty and sitting time) were identified irrespective of the measurement tools used to assess depression (i.e., either by self-report measures or the clinical measures).

Findings from the present study support those of previous research, which found that misperception exists in relation to other mood states including tiredness and aggression (Akram et al., 2016; Hall & Davidson, 1996). Such misperception may be explained by the hypothesis that human judgment and decision making is distorted by an array of cognitive, perceptual and motivational biases. Recent evidence suggests that people tend to recognize the operation of bias in human judgment, except when that bias is their own (Pronin, 2007). Despite the commonly recognized gender bias in self-perceptions (Pronin, 2007), the misperception of depression identified in the present study appeared to be consistent between male and females. The present findings that misperception exists in relation to self-reported depression have important implications for mental health research and practice. It is likely that self-reported depressive experience is measuring a different construct to that measured by a clinical tool and thus researchers must be clear on the construct that they wish to measure prior to conducting their research, as the present data suggests that self-reported measures of depression cannot be used interchangeably with clinical measures such as the PHQ-9. It is thus likely that as well that trends and levels other outcomes measured in relation to depression depends on whether self-report or validated tools are used. In support, the present study found different social-demographic correlates between self-reported depression and the PHQ-9.

The findings of our study should also be interpreted from a public health perspective. Higher perceptions of depression are associated with increased risk of impaired quality of life and unhealthy behaviors (Hall & Davidson, 1996), such as smoking and alcohol use (Buckner et al., 2007; Pronin, 2007). Awareness of such misperception should be increased among researchers and mental health practitioners. In light of the fact that the majority of misperception of depression is a result of overestimating severity of depression, our study highlights the need of providing the public with adequate health education on how to accurately assess depression levels and more accessible depression evaluation services, which may be important to reduce depression-induced negative behavioral outcomes.

Although the present study found several correlates that differed between self-reported depression and the PHQ-9, some consistent demographic (age, race/ ethnicity, poverty) and one behavior correlate (sitting time) were identified. Such correlates should be considered when designing interventions to reduce levels of depression in the US population (Grabovac et al., 2020). Correlates can inform interventions by highlighting potentially modifiable correlates that may bring about change in depression (e.g. sitting time), or identify characteristics of target groups most in need of intervention (e.g. age, race/ ethnicity, poverty). In particular, a large body of literature has shown an association between sedentary behavior (i.e. sitting time) and depression (Zhai, Zhang, & Zhang, 2015). The present findings further demonstrated that sitting time was a significant correlate for both self-report and clinically relative depression. Future research aiming to reduce population levels of depression should target sitting time and simultaneously consider the identified demographics in the present work.

A clear strength of this study is the novel investigation and identification of misperception in the context of depression in a large sample of US adults. This has important implications for both science and practice. A further strength is the identification of demographic and behavioral correlates that are consistent across varying constructs of depression. However, the results of the present study should be interpreted in light of its limitations. The present study investigated misperception of self-reported depression with the PHQ-9. The self-reported depression was assessed by asking the frequency of participants feeling depressed, which is insufficient to determine clinically relevant depression. Hence, it is not known whether such differences exist with other clinical depressive features and future research is required to establish this.

In conclusion, in this large sample of US adults, for the first time, we found that misperception existed in relation to reporting levels of depression. To combat the raising burden in depression among the US adults, there is a need for brief clinical screening tools at primary care settings to provide valid depression diagnosis. Meanwhile, such effort can be combined with healthcare provider facilitated interventions focusing on modifiable behaviors such as reducing sitting time.

**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

**Author Statement**

This project received no financial support.

**Declaration of Interest**

The authors declare no conflicts of interest.

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| **Table 1. Characteristics of US Adults by Depressive Symptoms (PHQ-9), NHANES 2015-2018a** |
|   | **No. of Participants (Weighted %)** |
|   | **PHQ-9 score <10** | **PHQ-9 score ≥10** |
| Overall | 9372 (100) | 885 (100) |
| Gender |  |  |
|  Men | 4665 (49.2) | 351 (37.7) |
|  Women | 4707 (50.8) | 534 (62.3) |
| Age group, y |  |  |
| 20-39 | 2163 (26.9) | 174 (26.4) |
| 40-59 | 2094 (25.4) | 200 (26.3) |
| ≥60 | 2412 (27.3) | 275 (28.9) |
| Race/ethnicity |  |  |
| Non-Hispanic white | 3179 (64.0) | 342 (63.0) |
| Non-Hispanic black | 2102 (11.3) | 183 (11.9) |
| Hispanic  | 2504 (15.4) | 253 (15.9) |
| Other | 1587 (9.4) | 107 (11.1) |
| Family poverty ratio |  |  |
|  <1.3 | 2434 (19.0) | 376 (39.5) |
|  1.3-<3.5 | 3392 (36.3) | 290 (36.4) |
|  ≥3.5 | 2502 (44.6) | 111 (24.8) |
| Education |  |  |
| <High school | 1794 (11.5) | 254 (19.0) |
| High school | 2051 (24.0) | 207 (27.2) |
| >High school | 5071 (64.5) | 382 (53.9) |
| Body mass index, kg/m2 |  |  |
| <25 | 2580 (27.9) | 202 (26.8) |
| 25-<30 | 2982 (31.6) | 217 (23.4) |
| ≥30 | 3716 (40.5) | 450 (49.9) |
| Leisure-time physical activityb |  |  |
| Inactive | 4688 (43.5) | 602 (61.5) |
| Active | 4684 (56.5) | 283 (38.5) |
| Sitting time, h |  |  |
| <4 | 2518 (23.0) | 201 (19.0) |
| 4-8 | 5000 (54.2) | 464 (52.7) |
| >8 | 1854 (22.8) | 220 (29.0) |
| Heart disease |  |  |
| Yes | 744 (6.4) | 141 (13.4) |
| Stroke |  |  |
| Yes | 320 (2.4) | 81 (7.8) |
| Cancer |  |  |
| Yes | 728 (8.1) | 88 (8.6) |
| Diabetes |  |  |
| Yes | 1329 (10.6) | 191 (17.3) |
| High cholesterol |  |  |
| Yes | 3526 (37.4) | 406 (42.6) |
| Hypertension |  |  |
| Yes | 4734 (45.7) | 508 (54.4) |
| a Sample size was weighted to be nationally representative.  |
| b Leisure-time physical activity level was defined by engaging in no (inactive) or any (active) moderate or vigorous recreational physical activity over the past 7 days |

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| **Table 2. Prevalence of Self-reported Depression and Depressive Symptoms****(PHQ-9) By Sociodemographic and Lifestyle Characteristics, NHANES 2015-2018a** |
|   | **Prevalence, % (95% CI)** |
|   | **Depressed Monthly** | **Depressed Weekly** | **PHQ-9 score ≥10** |
| Overall | 19.7 (18.5 to 20.9) |  | 11.3 (10.3 to 12.3) |  | 8.0 (7.3 to 8.7) |
| Sex |  |  |  |  |  |
| Male | 17.0 (15.4 to 18.6) |  | 9.8 (8.8 to 10.8) |  | 6.3 (5.4 to 7.1) |
| Female | 22.2 (20.7 to 23.7) |  | 12.7 (11.4 to 14.0) |  | 9.7 (8.4 to 10.9) |
| Race/ethnicity |  |  |  |  |  |
| Non-Hispanic white | 20.5 (18.8 to 22.2) |  | 11.7 (10.3 to 13.1) |  | 7.8 (6.7 to 9.0) |
| Non-Hispanic black | 18.2 (16.1 to 20.3) |  | 11.6 (10.0 to 13.2) |  | 8.2 (7.1 to 9.3) |
| Hispanic  | 18.6 (16.8 to 20.3) |  | 10.6 (9.4 to 11.8) |  | 8.3 (6.7 to 9.8) |
| Other | 18.1 (15.2 to 21.1) |  | 9.5 (7.4 to 11.6) |  | 8.7 (6.4 to 10.9) |
| Family poverty ratio |  |  |  |  |  |
|  <1.3 | 30.1 (27.2 to 33.0) |  | 19.3 (16.5 to 22.2) |  | 15.2 (13.1 to 17.2) |
|  1.3-<3.5 | 20.9 (19.1 to 22.7) |  | 12 (10.5 to 13.5) |  | 8.0 (6.8 to 9.1) |
|  ≥3.5 | 13.9 (11.8 to 15.9) |  | 6.6 (5.1 to 8) |  | 4.5 (3.6 to 5.3) |
| Education |  |  |  |  |  |
| <High school | 24.2 (20.9 to 27.5) |  | 17.4 (14.3 to 20.5) |  | 12.6 (10.4 to 14.7) |
| High school | 21.9 (19.8 to 24.0) |  | 12.7 (10.6 to 14.8) |  | 9.0 (7.5 to 10.4) |
| >High school | 17.8 (16.3 to 19.3) |  | 9.5 (8.6 to 10.5) |  | 6.8 (5.9 to 7.6) |
| Body mass index, kg/m2 |  |  |  |  |  |
| <25 | 20.7 (18.4 to 23.0) |  | 11.4 (9.8 to 13.1) |  | 7.7 (6.3 to 9.2) |
| 25-<30 | 17.3 (15.2 to 19.5) |  | 9.7 (8.3 to 11) |  | 6.1 (4.9 to 7.2) |
| ≥30 | 20.9 (19.1 to 22.6) |  | 12.5 (10.8 to 14.1) |  | 9.7 (8.6 to 10.8) |
| Leisure-time physical activityb |  |  |  |  |
| Inactive | 21.9 (20.2 to 23.6) |  | 13.5 (11.9 to 15.1) |  | 11.0 (9.7 to 12.3) |
| Active | 17.9 (16.3 to 19.4) |  | 9.5 (8.6 to 10.3) |  | 5.6 (4.8 to 6.4) |
| Sitting time, h |  |  |  |  |  |
| <4 | 18.7 (16.4 to 21.1) |  | 11.7 (9.4 to 14) |  | 6.7 (5.0 to 8.3) |
| 4-8 | 19.7 (17.9 to 21.4) |  | 10.7 (9.5 to 12) |  | 7.8 (6.8 to 8.8) |
| >8 | 20.6 (17.8 to 23.5) |  | 12.2 (10.2 to 14.1) |  | 9.8 (7.9 to 11.8) |
| Heart disease |  |  |  |  |  |
| Yes | 27.5 (23.3 to 31.6) |  | 18.8 (15 to 22.5) |  | 15.5 (12.7 to 18.4) |
| Stroke |  |  |  |  |  |
| Yes | 36.2 (29.5 to 43.0) |  | 26.3 (20.8 to 31.7) |  | 21.0 (15.4 to 26.6) |
| Cancer |  |  |  |  |  |
| Yes | 19.5 (16.1 to 22.8) |  | 12.3 (9.8 to 14.8) |  | 8.2 (5.5 to 10.9) |
| Diabetes |  |  |  |  |  |
| Yes | 20.7 (17.3 to 24.1) |  | 13.8 (10.9 to 16.7) |  | 12.4 (10.3 to 14.5) |
| High cholesterol |  |  |  |  |  |
| Yes | 20.6 (18.6 to 22.7) |  | 12.2 (10.5 to 13.9) |  | 9.0 (8.1 to 10.0) |
| Hypertension |  |  |  |  |  |
| Yes | 21.2 (19.7 to 22.8) |  | 12.8 (11.5 to 14.1) |  | 9.4 (8.6 to 10.2) |
| Medicine usec |  |  |  |  |  |
| Yes | 62.6 (58.3 to 66.9) |   | 44.8 (40.2 to 49.4) |   | 29.7 (26.0 to 33.4) |
| a All estimates were weighted to be nationally representative.  |
| b Leisure-time physical activity level was defined by engaging in no (inactive) or any (active) moderate or vigorous recreational physical activity over the past 7 days |
| c Taking medicine for depression was used for self-reported and PHQ-9 based depression |

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| **Table 3. Weighted Logistic Regression Models of Self-reported Depression and Depressive Symptoms (PHQ-9) Adjusted for Sociodemographic and Lifestyle Characteristics, NHANES 2015-2018a** |
|   | **Odds Ratio (95% CI)** |  |  |  |  |
|   | **Depressed Monthly** |  | **Depressed Weekly** |  | **PHQ-9 score ≥10** |
| Age, y | 0.98 (0.97 to 0.98) |  | 0.99 (0.98 to 0.99) |  | 0.98 (0.97 to 0.99) |
| Sex |  |  |  |  |  |
| Male | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| Female | 1.16 (0.99 to 1.37) |  | 1.07 (0.90 to 1.27) |  | 1.41 (1.10 to 1.83) |
| Race/ethnicity |  |  |  |  |  |
| Non-Hispanic white | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| Non-Hispanic black | 0.66 (0.54 to 0.82) |  | 0.78 (0.62 to 0.98) |  | 0.78 (0.61 to 1.00) |
| Hispanic  | 0.77 (0.61 to 0.97) |  | 0.70 (0.50 to 1.00) |  | 0.82 (0.54 to 1.25) |
| Other | 0.78 (0.56 to 1.08) |  | 0.72 (0.51 to 1.03) |  | 1.12 (0.71 to 1.76) |
| Family poverty ratio |  |  |  |  |  |
|  <1.3 | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
|  1.3-<3.5 | 0.65 (0.55 to 0.77) |  | 0.63 (0.48 to 0.84) |  | 0.53 (0.41 to 0.69) |
|  ≥3.5 | 0.38 (0.29 to 0.49) |  | 0.32 (0.21 to 0.47) |  | 0.31 (0.23 to 0.43) |
| *P* for trendb | <0.001 |  | <0.001 |  | <0.001 |
| Education |  |  |  |  |  |
| <High school | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| High school | 0.95 (0.72 to 1.24) |  | 0.72 (0.50 to 1.04) |  | 0.83 (0.57 to 1.20) |
| >High school | 0.72 (0.56 to 0.93) |  | 0.54 (0.41 to 0.72) |  | 0.69 (0.50 to 0.94) |
| *P* for trendb | 0.002 |  | <0.001 |  | 0.009 |
| Body mass index, kg/m2 |  |  |  |  |  |
| <25 | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| 25-<30 | 0.82 (0.66 to 1.02) |  | 0.84 (0.65 to 1.09) |  | 0.73 (0.53 to 1.00) |
| ≥30 | 0.79 (0.64 to 0.99) |  | 0.82 (0.61 to 1.09) |  | 0.89 (0.65 to 1.23) |
| *P* for trendb | 0.103 |  | 0.175 |  | 0.99 |
| Leisure-time physical activityc |  |  |  |  |  |
| Inactive | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| Active | 0.99 (0.84 to 1.17) |  | 0.94 (0.79 to 1.12) |  | 0.66 (0.50 to 0.87) |
| Sitting time, h |  |  |  |  |  |
| <4 | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| 4-8 | 1.15 (0.91 to 1.46) |  | 0.98 (0.73 to 1.30) |  | 1.35 (0.98 to 1.85) |
| >8 | 1.25 (1.00 to 1.57) |  | 1.17 (0.86 to 1.59) |  | 1.87 (1.20 to 2.91) |
| *P* for trendb | 0.036 |  | 0.256 |  | 0.006 |
| Heart disease |  |  |  |  |  |
| No | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| Yes | 1.44 (1.05 to 1.96) |  | 1.37 (0.98 to 1.92) |  | 1.53 (1.07 to 2.17) |
| Stroke |  |  |  |  |  |
| No | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| Yes | 1.78 (1.17 to 2.70) |  | 1.86 (1.10 to 3.15) |  | 1.49 (0.85 to 2.61) |
| Cancer |  |  |  |  |  |
| No | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| Yes | 0.91 (0.69 to 1.19) |  | 0.90 (0.62 to 1.30) |  | 0.71 (0.46 to 1.11) |
| Diabetes |  |  |  |  |  |
| No | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| Yes | 0.99 (0.73 to 1.33) |  | 1.07 (0.80 to 1.44) |  | 1.43 (1.10 to 1.84) |
| High cholesterol |  |  |  |  |  |
| No | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| Yes | 1.13 (0.92 to 1.40) |  | 1.07 (0.84 to 1.36) |  | 1.03 (0.78 to 1.36) |
| Hypertension |  |  |  |  |  |
| No | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| Yes | 1.23 (0.99 to 1.53) |  | 1.12 (0.89 to 1.41) |  | 1.15 (0.84 to 1.59) |
| Medicine used |  |  |  |  |  |
| No | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| Yes | 10.5 (8.33 to 13.2) |  | 10.6 (8.51 to 13.17) |  | 6.66 (5.23 to 8.48) |
| a All estimates were weighted to be nationally representative. |
| b P for trend was calculated using continuous variable. |
| c Leisure-time physical activity level was defined by engaging in no (inactive) or any (active) moderate or vigorous recreational physical activity over the past 7 days |
| d Taking medicine for depression was adjusted in the model for self-reported and PHQ-9 based depression |

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| **Table 4. NHANES Participant Breakdown of Categorization Based on Depression Severity (PHQ-9 score) and Cross Tabulation with Frequency of Self-reported Depression, NHANES 2015-2018a,b** |
|  | **Depression Severity (PHQ-9 score)** |
| **Unweighted N** | **None**  | **Mild**  | **Moderate**  | **Moderately severe** | **Severe**  |
| **Weighted %** | **(0-4)** | **(5-9)** | **(10-14)** | **(15-19)** | **(20-27)** |
| Self-reported Depression |  |  |  |  |  |
| Never | 90,660,930 | 6,901,335 | 1,047,815 | 70,899 | 18,658 |
| **55.7** | **19.7** | **9.3** | **1.6** | **1.1** |
| A few times a year | 56,931,138 | 13,100,215 | 3,013,474 | 544,844 | 70,011 |
| **35.0** | **37.5** | **26.8** | **12.6** | **4.2** |
| Monthly | 9,644,198 | 5,932,003 | 1,758,691 | 550,783 | 101,205 |
| **5.9** | **17.0** | **15.7** | **12.7** | **6.0** |
| Weekly | 4,247,016 | 5,986,359 | 3,010,043 | 861,175 | 342,076 |
| **2.6** | **17.1** | **26.8** | **19.9** | **20.3** |
| Daily | 1,316,876 | 3,038,803 | 2,405,084 | 2,298,744 | 1,150,380 |
| **0.8** | **8.7** | **21.4** | **53.1** | **68.4** |
| a Blue was considered as the “Under-estimators” of depression; Orange was considered as the “Over-estimators” of depression; Green was considered as the “Accurate-estimators” of depression. |
| b Agreement between self-reported depression and clinical depression: agreement=50.98%, Cohen’sKappa=0.16; Person p <0.001 |