**Healthcare Providers’ Advice on Lifestyle Modification in the US Population: Results from the National Health and Nutrition Examination Survey 2011-2016**

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**ABSTRACT**

**Objective:** Healthcare providers are encouraged to prescribe lifestyle modifications for preventing and managing obesity and associated chronic conditions. However, the pattern of lifestyle advice provision is unknown. We investigate the prevalence of advised lifestyle modification according to weight status and chronic conditions in a US nationally representative sample.

**Methods:** Adults 20-64 years (n=11,467) from National Health and Nutrition Examination Study between 2011 and 2016 were analyzed, with weight status, and chronic conditions (high blood pressure, high blood cholesterol, osteoarthritis, coronary heart disease and type 2 diabetes mellitus). Lifestyle modification advice by healthcare providers included increase physical activity/exercise, reduce dietary fat/calories, control/lose weight, and all of above.

**Results:** High blood pressure (32.7%) and cholesterol (29.3%) were highly prevalent compared to osteoarthritis (7.4%), type 2 diabetes (5.7%) and coronary heart disease (3.7%). Those with type 2 diabetes received considerably frequent advice (56.5%; 95%CI: 52.4%-60.6%) than those with high blood pressure (31.4%; 95%CI:29.3%-33.6%) and cholesterol (27.0%; 95%CI:24.9%-29.3%). Prevalence of lifestyle advice exhibited substantial increases with graded BMI and comorbidity (all P<0.001). After adjusting for comorbid conditions, advice were more commonly reported among women, those overweight/obese, non-white, or insured. Remarkably low proportion of overweight (21.4: 95%CI: 18.7-24.3%) and obese (44.2%;95%CI:41.0%-47.4%) adults free of chronic conditions reported receiving any lifestyle advice.

**Conclusions:** Prevalence of lifestyle modification advised by healthcare providers is generally low among US adults with chronic conditions, and worryingly low among those without chronic conditions however overweight or obese. Prescribed lifestyle modification is a missing opportunity in implementing sustainably strategies reducing chronic condition burden.

**INTRODUCTION**

Lifestyle factors such as suboptimal diet and physical inactivity (i.e. not meeting recommended physical activity guidelines) are recognized causes of overweight and obesity driving an undisputed public health challenge.[1](#_ENREF_1) Obesity prevalence has been increasing worldwide,[2-5](#_ENREF_2) bringing an increase of adiposity-related chronic conditions that increase the risk of premature mortality, morbidity, and long-term disability.[6](#_ENREF_6)[7](#_ENREF_7) Obesity and its comorbid conditions are a problem of particular concern in the United States: in 2013, a report by the Institute of Medicine (IOM) documented the US being less healthy in key areas (including diabetes, obesity, heart disease, among others) compared to 16 other high income countries.[8](#_ENREF_8) In 2015-2016, prevalence of obesity in US adults was 39.8%, continuing an upwards trend.[9](#_ENREF_9) Rates of type 2 diabetes mellitus (T2DM),[10](#_ENREF_10)[11](#_ENREF_11) coronary heart disease,[12](#_ENREF_12)[13](#_ENREF_13) high blood cholesterol,[14](#_ENREF_14) high blood pressure[15](#_ENREF_15)[16](#_ENREF_16) and osteoarthritis[17](#_ENREF_17)[18](#_ENREF_18) – prevalent chronic diseases with excess adiposity as an established cause – have also increased substantially in the US over recent decades.[19](#_ENREF_19)[20](#_ENREF_20) With more than half of US adults reporting one chronic condition, and over a quarter having two or more, chronic diseases account for a large proportion of national health expenditure.[20](#_ENREF_20)

To reduce this disease burden, weight control, increases in physical activity and improvements in diet are necessary through a range of clinic-, community, and environmental based approaches.[21](#_ENREF_21) Community programs need to support health and strengthen the links between communities and healthcare providers in order to empower patients to better manage their health outside the clinical setting.[22](#_ENREF_22) However, trends in increasing these protective factors (e.g. physical activity and blood pressure control) have stalled in recent years.[23](#_ENREF_23)

Brief advice on lifestyle modification from healthcare providers appears to be an effective way of promoting health behaviour change.[24](#_ENREF_24)A recent meta-analysis suggested that overweight/obese adults who received advice were near four times more likely to attempt to lose weight than those who received no such advice.[24](#_ENREF_24)[25](#_ENREF_25) The importance of healthcare providers’ giving patients lifestyle advice has been highlighted by international guidelines.[26](#_ENREF_26)[27](#_ENREF_27) In 2012, the IOM summarised several population-based obesity prevention strategies, naming nutrition, weight and physical activity-related counselling by healthcare providers key strategies to provide standardized care and advocate for health in the community.[28](#_ENREF_28) However, percentage of people with obesity who are advised to manage their weight is unclear. Previous studies, mostly conducted around 10 years ago, reported low prevalence of lifestyle prescription in the US.[29-34](#_ENREF_29) The current prevalence and patterns of HCPs’ provision of advice for lifestyle modification is unknown.

Drawing on the recent nationally representative National Health and Nutrition Examination Survey (NHANES) 2011-2016 data, we describe for the first time the prevalence and patterns of healthcare providers advised lifestyle modification received by US adults according to their weight and chronic condition status. We restricted our sample to adults aged 20-64 years because majority of older adults (≥65 years) are US Medicare beneficiaries with differed health providers. This analysis 1) describe the prevalence of lifestyle advice among individuals free of chronic conditions, and those with high blood pressure, high blood cholesterol level, osteoarthritis, coronary heart disease and T2DM by weight status; 2) evaluate the associations between comorbidity and the likelihood of receiving healthcare providers’ lifestyle advice; and 3) examine the correlates of receiving healthcare providers’ lifestyle advice among US adults. Such information is crucial for understanding and informing clinical practice, priority-setting, and decision making across multiple levels of the healthcare system in chronic disease prevention and control.

**MATERIALS AND METHODS**

Study Population

NHANES was designed to provide cross-sectional estimates of the prevalence of health, nutrition, and potential risk factors among the civilian non-institutionalized US population[35](#_ENREF_35) using a nationally representative complex, stratified, multistage, probability clustered sample. We extracted data on sociodemographic characteristics, body measurements, medical conditions, and lifestyle characteristics in the latest three waves from 2011-2012 to 2015-2016, and excluded those who were younger than 20 or 65 years and older, living with physical function limitation (walking for a quarter mile or walking up ten steps difficulty for adults), or pregnant.

Healthcare providers’ advice on lifestyle modifications

Participants were asked “To lower your risk of certain disease, during the past 12 months have you ever been told by a doctor or health professional to: increase your physical activity or exercise / reduce the amount of fat or calories in your diet / control weight or lose weight?” Response options were yes (received lifestyle advice) and no (lifestyle advice not received). Participants reporting receiving all three lifestyle advice were also identified as a separate group owing to the stronger weight management effect of combined physical activity and diet changes than either one alone.[36](#_ENREF_36)

Chronic conditions

Five highly prevalent chronic conditions that have excess adiposity as an established risk factor were included: high blood pressure, high blood cholesterol level, osteoarthritis, coronary heart disease and T2DM.

Participants with high blood pressure and cholesterol were identified using both self-reported and laboratory examinations. The details of blood pressure and laboratory cholesterol measurements are described elsewhere.[37](#_ENREF_37)[38](#_ENREF_38) High blood pressure was determined if they were told they had high blood pressure or hypertension by a health professional, 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.[39](#_ENREF_39) High blood cholesterol were determined by self-reported being told by health professional , or if their measured total cholesterol level was 6.2 mmol/L (240 mg/DL) or higher.[40](#_ENREF_40) Osteoarthritis was determined by participant self-reporting being told they had osteoarthritis or degenerative arthritis by a health professional.[41](#_ENREF_41) Coronary heart disease was defined based on participants’ self-reported conditions of congestive heart failure, angina, heart attack, or coronary heart disease diagnosed. Structured interview questions on chest pain were further used to classify angina based on existing Rose angina criteria.[42](#_ENREF_42) Participants were considered as having diabetes if they were told by a health professional or reported taking insulin.

Weight status

Weight and height were measured during a physical examination following standard procedures. Body mass index (BMI) was calculated as weight in kg/(height in meters)2 and categorized into: underweight (<18.5 kg/m2), normal weight (18.5–24.9 kg/m2), overweight (25.0–29.9 kg/m2), and obesity (≥30 kg/m2) based on the standard classification.[43](#_ENREF_43) For analytic purposes, we exclude those who were underweight due to potential underlying health conditions.

Covariates

Self-reported socio-demographic characteristics included age, gender, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Asian, and others), annual household income ($25,000 or less, $25,000 to $74,999, and $75,000 or above), insurance (uninsured, insured with public insurance, and insured with private insurance) and education (less than high school, high school, and above high school). Lifestyle characteristics included leisure time physical activity and smoking status. Participants reported the number of days and minutes spent in moderate recreational 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), and active (any moderate-to-vigorous physical activity) based on the physical activity guideline.[44](#_ENREF_44) 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), and current smokers (smoked 100 cigarettes in life and smoke now).

Analysis

All statistical analyses were performed using STATA version 14.0 (STATA Corp., College Station, Texas, USA). Survey analysis procedures were used to account for the sample weights, stratification, and clustering of the complex sampling design to ensure nationally representative estimates.[45](#_ENREF_45) We calculated weighted proportion of participants receiving lifestyle advice for each morbidity condition in overall population and by BMI category.. Additionally, we calculated the weighted proportion of participants who currently not receiving any lifestyle modification advice from their healthcare providers according to morbidity condition and BMI category.

We estimated the unadjusted and multivariable adjusted associations of chronic condition (free or chronic condition, one chronic condition, comorbidity) with the likelihood of receiving lifestyle advice in each BMI category using odds ratios (ORs). Finally, multivariable adjusted logistic regressions were used to identify correlates for receiving lifestyle advice while modelling chronic conditions as a categorical variable (0 indicates free of chronic conditions, and 1-5 indicate each chronic condition). Multivariate adjustments include age (continuous), gender, BMI category, race/ethnicity, household income, health insurance status, leisure time physical activity, education level, and smoking status. All statistical significance was set at *P*<0.05. P-values were not adjusted for multiple tests and should be interpreted explanatorily only.

**RESULTS**

Overall, data on 11 467 (weighted n= 31 142 531) adults were included in the analysis. Table 1 presents the unweighted sample size of chronic conditions in the US population overall and by gender, BMI, race/ethnicity and smoking status. The most prevalent chronic conditions were high blood cholesterol (weighted proportion 32.7%) and high blood pressure (weighted proportion 29.3%) followed by osteoarthritis (7.4%), T2DM (5.7%) and coronary heart disease (3.7%). Up to 20.7% of the adult population (20-64 years) had at least two coexisting chronic conditions.

**Prevalence of healthcare providers’ advice on lifestyle modifications**

Despite its relative low prevalence, adults with T2DM received lifestyle advice most often (56.5%, 95%CI: 52.4-60.6%), followed by those with coronary heart disease (34.6%, 95%CI: 28.9%-40.7%) and osteoarthritis (34.9%, 95%CI: 31.0-39.1%). In contrast, adults living with highly prevalent chronic conditions such as high blood pressure and cholesterol received lifestyle advice less frequently (31.4%, 95%CI: 29.3%-33.6% and 27.0%, 95%CI: 24.9-29.3%, respectively) (Table 2). This pattern was consistently observed within each BMI category (Table 2 and Figure 1). The prevalence of lifestyle advice was the lowest among individuals free of chronic conditions. Among normal weight adults who were free of chronic conditions, only 9.8% (95%CI: 8.2%-11.8%) were advised to exercise and 1% (95%CI: 0.4%-2.2%) received all advice. Overweight and obese adults free of chronic conditions received lifestyle advice more frequently than normal weight individuals, with 22.4% (95%CI: 18.7%-24.3%) overweight and 44.2% (95%CI: 41.0%-47.4%) obese adults received at least one lifestyle advice, however leaving 78.6% and 55.8% of this group of adults completely absent of any lifestyles advice (Supple table 1). Among those free of chronic conditions, despite being obese, only 37.1% (95%CI: 33.9%-40.5%) were advised to exercise, 27.2% (95%CI: 22.4%-31.1%) were advised to reduce fat or calorie intake, and 33.8% (95%CI: 31.3%-36.5%) were advised to control or lose weight (Table 2, Figure 1).

**Comorbidity and healthcare providers’ advice on lifestyle modifications**

For each lifestyle advice, prevalence increased with graded BMI across all chronic condition statuses (Figure 1). In each BMI category, prevalence of being advised to exercise and reduce fat/calories exhibited substantial increases with comorbidity (all P values for trend <.001) adjusting for age, gender, race/ethnicity, household income, health insurance status, leisure time physical activity, education level and smoking status (Table 3). Among overweight and obese participants, there was an increased trend of being advised to control/lose weight with comorbidity (both P values for trend <.001). While the odds of receiving an advice to control/lose weight were not significantly higher among normal weight adults with one chronic condition compared to those who were free of chronic conditions (OR=1.2, 95%CI: 0.6-2.2), having two or more comorbidities was associated with markedly higher odds of being advised to control/lose weight (OR=5.0, 95%CI: 2.5-10.1) (Table 3).

Multivariable-adjusted logistic regression identified a few correlates for lifestyle advice. After adjusting for all chronic conditions, healthcare providers’ advice on lifestyle modification were consistently more commonly reported among women, graded BMI, non-white race/ethnicity , and being insured, regardless of non-private or private insurance (all P values <.004) (Table 4).

**DISCUSSION**

We quantify the cross-sectional relationship of weight-associated chronic conditions with healthcare provider’s advice on lifestyle modification in a contemporary nationally representative sample of US adults 20 to 64 years old. High blood pressure and cholesterol were particularly prevalent compared to osteoarthritis, T2DM and coronary heart disease. However, participants with T2DM and coronary heart disease were most likely to receive lifestyle advice. The prevalence of lifestyle advice increased with BMI for each included chronic condition, and increased dramatically with number of comorbidity. After adjusting for all comorbid conditions, receiving lifestyle advice was more frequently reported among women, and those who were overweight or obese, non-white, or insured.

A recent CDC study used National Health Interview Survey data evaluating trends of weight loss counselling among patients with arthritis, reporting 23.8% overweight and 62.8% obese adults with arthritis receiving weight loss counselling .[46](#_ENREF_46) Albeit approximately agreeing with our findings, their study did not distinguish types of advice given, precluding a clear comparison.

Importantly, our analyses released that fewer than 20% of overweight and less than 40% of obese adults received any lifestyle modification advice when free of chronic disease, demonstrating that most healthcare providers are missing this crucial primary prevention opportunity as recommended by numerous guidelines.[26-28](#_ENREF_26) Although the low prevalence of lifestyle advice is a cause for concern, it is still more encouraging than the critical low weight management advice (2.6%) reported by Lutfiyya et al in 2008.[30](#_ENREF_30) In fact, previous studies mostly included single lifestyle advice, or single chronic condition, possible due to the lack of systematically collected data.[29-34](#_ENREF_29) For the first time, our study mapped out the contemporary patterns of multiple lifestyle modifications advised by healthcare providers and systematically evaluated their patterns according to a number of prevalent chronic conditions, revealing alarmingly low rates of lifestyle advice available to US adults in the healthcare setting.

The reasons for low rates of advice provided is possibly related to general pessimism of healthcare providers concerning the success of weight loss strategies. Primary care physicians in the US likely to consider obesity treatments as less effective than treatment of all chronic issues.[47](#_ENREF_47) Physicians also quote lack of confidence and skills and perceiving the problems as too complex.[48](#_ENREF_48) Meanwhile, this kind of disillusionment has been identified as a barrier in providing the necessary recommendations.[49](#_ENREF_49) Another factor that may discourage physicians from broaching the topic of lifestyle modification is perceived lack of time, yet studies have shown that counselling sessions of as little as 5 minutes[50](#_ENREF_50)[51](#_ENREF_51) or even 30 seconds[52](#_ENREF_52) could be effective. Fears that patients will find such interventions rude were also unfounded as under 1% of patients found this kind of opportunistic intervention as inappropriate.[52](#_ENREF_52)

Our findings on healthcare providers’ advice on lifestyle modification being more commonly reported among women, overweight or obese adults, non-white, or insured US population are in accord with a previous study of around 1700 obese Mexican-American adults.[31](#_ENREF_31) Their study reported that men, unmarried individuals, those less educated and preferred to talk Spanish at home and without comorbidities were less likely to receive lifestyle modification advice. The disparate pattern observed in our analyses indicates the needs to strengthen the implementation of lifestyle modification advice, particularly among men. Meanwhile community-based lifestyle modification support should be designed accessible to the uninsured.

The rising trends in overweight and obesity, as well as associated chronic conditions in the US population, warrant timely attention from health policy and health care system decision makers. The management of chronic conditions is complex and requires multi-level approaches through individual, health professional, community, environment and policy engagement. The rapid increase in population weight and associated chronic conditions calls for greater efforts adopting population-based strategies to reduce modifiable risk factors in a favourable direction in the population. Primary care efforts are urgently needed for preventing and treating obesity as well as altering societal norms.[53](#_ENREF_53)[54](#_ENREF_54) In 2012, the IOM identified several population-based obesity prevention strategies that target physical activity, healthy diet, and shaping healthy social norms, as well as provided recommendations on setting-specific implementations of the strategies to combat obesity.[28](#_ENREF_28) Nutrition, weight counselling and physical activity-related counselling by healthcare providers were listed as key strategies to provide standardized care and advocate for healthy community environment.[28](#_ENREF_28) They also summarize specific key metrics to evaluate the progress of obesity prevention strategies towards sustainable implementation.[55](#_ENREF_55) Delivering these strategies is a priority to reduce the burden of obesity on contemporary and future generations.

**Conclusion**

Prevalence of healthcare providers’ advice on lifestyle modification is low among US adults with obesity-associated chronic conditions, with worryingly low proportions of US adults free from chronic conditions receives any lifestyle advice. Healthcare provider prescribed lifestyle modifications, a sustainable strategy in reducing burden of obesity and chronic condition, should be widely implemented. Our findings highlight a substantial window of opportunity to increase preventive efforts. In addition, we identified a need for lifestyle modification support to be accessible to the uninsured population through community engagement in the US.

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| **Table 1. Sample Size for Chronic Condition Status in the US Adults 20-64 Years, NHANES 2011-2016** a |
|   | **Free of chronic conditionb** | **High blood pressure** | **High blood cholesterol** | **Osteoarthritis** | **Type 2 diabetes mellitus** | **Coronary heart disease** | **Comorbidity (≥2)** |
| **Overall** | 5617 | 3599 | 3693 | 690 | 829 | 496 | 2474 |
| **Gender** |  |  |  |  |  |  |  |
| Men | 2665 | 1885 | 1977 | 276 | 430 | 254 | 1276 |
| Women | 2952 | 1714 | 1716 | 414 | 399 | 242 | 1198 |
| **BMI** |  |  |  |  |  |  |  |
| <25 kg/m2 | 2320 | 630 | 822 | 132 | 102 | 86 | 382 |
| 25 - <30 kg/m2 | 1703 | 1059 | 1310 | 183 | 217 | 141 | 765 |
| ≥30 kg/m2 | 1594 | 1910 | 1561 | 375 | 510 | 269 | 1327 |
| **Race/ethnicity** |  |  |  |  |  |  |  |
| Non-Hispanic white | 1875 | 1134 | 1273 | 353 | 193 | 179 | 828 |
| Non-Hispanic black | 1160 | 1139 | 789 | 142 | 237 | 138 | 699 |
| Hispanic | 1459 | 866 | 1023 | 128 | 285 | 131 | 641 |
| Asian | 932 | 336 | 496 | 31 | 87 | 30 | 228 |
| Other | 191 | 124 | 112 | 36 | 27 | 18 | 78 |
| **Health insurance status** |  |  |  |  |  |  |  |
| Uninsured | 1697 | 802 | 780 | 98 | 170 | 101 | 471 |
| Non-private insurance | 971 | 978 | 821 | 219 | 255 | 228 | 732 |
| Private insurance | 2945 | 1817 | 2088 | 373 | 404 | 167 | 1270 |
| **Smoking status** |  |  |  |  |  |  |  |
| Never | 3702 | 1897 | 2053 | 325 | 451 | 198 | 1252 |
| Former | 753 | 808 | 860 | 181 | 217 | 127 | 625 |
| Current | 1162 | 894 | 780 | 184 | 161 | 171 | 597 |

a Free of high blood pressure, high blood cholesterol, osteoarthritis, type 2 diabetes, coronary heart disease

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| **Table 2. Weighted Prevalence (%) of Healthcare Providers’ Advice on Lifestyle Modification according to Chronic Condition Status in US Adults 20-64 years, NHANES 2011-2016** |
|   | **Exercise**  |  | **Reduce fat/calories** |  | **Control/lose weight** |  | **All of above** |
| **Free of chronic disease** | **20.1** | **(18.4 to** | **21.9)** |  | **11.1** | **(9.7 to** | **12.7)** |  | **13.3** | **(11.8 to** | **14.9)** |  | **7.7** | **(6.7 to** | **8.8)** |
| <25 kg/m2 | 9.8 | (8.2 to | 11.8) |   | 2.5 | (1.7 to | 3.6) |   | 2.0 | (1.3 to | 3.1) |   | 1.0 | (0.4 to | 2.2) |
| 25 - <30 kg/m2 | 18.3 | (15.9 to | 21.0) |   | 8.0 | (6.4 to | 10.0) |   | 9.7 | (7.8 to | 12.0) |   | 4.3 | (3.1 to | 5.7) |
| ≥30 kg/m2 | 37.1 | (33.9 to | 40.5) |   | 27.2 | (24.4 to | 30.1) |   | 33.8 | (31.3 to | 36.5) |   | 21.2 | (19.0 to | 23.6) |
| *P* for trend | < .001 |   | < .001 |   | < .001 |   | < .001 |
| **High blood pressure** | **49.7** | **(47.2 to** | **52.3)** |  | **41.3** | **(39.1 to** | **43.5)** |  | **41.4** | **(39.0 to** | **43.8)** |  | **31.4** | **(29.3 to** | **33.6)** |
| <25 kg/m2 | 23.9 | (19.9 to | 28.4) |   | 14.3 | (11.4 to | 17.8) |   | 5.2 | (3.3 to | 7.9) |   | 2.9 | (1.7 to | 4.9) |
| 25 - <30 kg/m2 | 37.6 | (32.6 to | 42.7) |   | 31.5 | (27.2 to | 36.0) |   | 24.0 | (19.7 to | 28.9) |   | 18.9 | (15.3 to | 23.1) |
| ≥30 kg/m2 | 64.8 | (61.2 to | 68.3) |   | 55.3 | (52.2 to | 58.4) |   | 62.7 | (60.2 to | 65.2) |   | 47.6 | (44.3 to | 50.9) |
| *P* for trend | < .001 |   | < .001 |   | < .001 |   | < .001 |
| **High blood cholesterol** | **45.3** | **(42.7 to** | **47.8)** |  | **39.2** | **(37.1 to** | **41.3)** |  | **35.2** | **(32.8 to** | **37.7)** |  | **27.0** | **(24.9 to** | **29.3)** |
| <25 kg/m2 | 24.8 | (20.5 to | 29.6) |   | 15.9 | (12.4 to | 20.0) |   | 7.0 | (4.5 to | 10.6) |   | 4.0 | (2.5 to | 6.3) |
| 25 - <30 kg/m2 | 39.1 | (34.7 to | 43.6) |   | 33.7 | (30.0 to | 37.6) |   | 24.2 | (20.8 to | 28.1) |   | 18.8 | (15.5 to | 22.6) |
| ≥30 kg/m2 | 61.0 | (57.3 to | 64.6) |   | 55.6 | (52.7 to | 58.5) |   | 59.1 | (55.9 to | 62.1) |   | 45.8 | (42.4 to | 49.3) |
| *P* for trend | < .001 |   | < .001 |   | < .001 |   | < .001 |
| **Osteoarthritis** | **54.2** | **(49.8 to** | **58.4)** |  | **45.5** | **(41.2 to** | **49.8)** |  | **45.6** | **(40.8 to** | **50.4)** |  | **34.9** | **(31.0 to** | **39.1)** |
| <25 kg/m2 | 29.2 | (19.8 to | 40.8) |   | 9.9 | (4.9 to | 18.8) |   | 6.2 | (2.3 to | 15.7) |   | 2.7 | (0.5 to | 13.1) |
| 25 - <30 kg/m2 | 44.6 | (36.5 to | 53.0) |   | 40.4 | (30.2 to | 51.5) |   | 26.3 | (18.9 to | 35.4) |   | 21.9 | (15.1 to | 30.7) |
| ≥30 kg/m2 | 69.4 | (63.1 to | 75.0) |   | 62.1 | (55.8 to | 68.1) |   | 72.1 | (67.1 to | 76.6) |   | 55.1 | (48.4 to | 61.6) |
| *P* for trend | < .001 |   | < .001 |   | < .001 |   | < .001 |
| **Coronary heart disease** | **59.3** | **(51.8 to** | **66.3)** |  | **53.3** | **(47.8 to** | **58.8)** |  | **44.5** | **(38.2 to** | **51.0)** |  | **34.6** | **(28.9 to** | **40.7)** |
| <25 kg/m2 | 32.4 | (20.7 to | 46.8) |   | 31.3 | (19.1 to | 46.8) |   | 8.0 | (2.8 to | 21.0) |   | 6.7 | (1.9 to | 20.5) |
| 25 - <30 kg/m2 | 55.8 | (43.6 to | 67.3) |   | 41.1 | (30.2 to | 53.0) |   | 26.4 | (18.8 to | 35.7) |   | 16.7 | (10.9 to | 24.8) |
| ≥30 kg/m2 | 70.3 | (62.3 to | 77.2) |   | 67.3 | (59.8 to | 73.9) |   | 66.5 | (58.2 to | 74.0) |   | 53.5 | (46.2 to | 60.7) |
| *P* for trend | < .001 |   | < .001 |   | < .001 |   | < .001 |
| **Type 2 diabetes mellitus** | **74.6** | **(69.8 to** | **78.8)** |  | **67.3** | **(62.7 to** | **71.6)** |  | **69.2** | **(64.6 to** | **73.5)** |  | **56.5** | **(52.4 to** | **60.6)** |
| <25 kg/m2 | 60.7 | (46.1 to | 73.6) |   | 32.7 | (20.9 to | 47.1) |   | 28.3 | (16.5 to | 44.1) |   | 16.9 | (8.6 to | 30.6) |
| 25 - <30 kg/m2 | 55.0 | (45.9 to | 63.8) |   | 51.9 | (44.2 to | 59.6) |   | 41.9 | (33.2 to | 51.2) |   | 36.2 | (28.0 to | 45.3) |
| ≥30 kg/m2 | 83.0 | (77.3 to | 87.6) |   | 77.8 | (71.0 to | 83.3) |   | 84.4 | (78.7 to | 88.8) |   | 69.4 | (63.4 to | 74.7) |
| *P* for trend | < .001 |   | < .001 |   | < .001 |   | < .001 |

a All estimates were weighted to be nationally representative.

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| **Table 3. Weighted Multivariable Adjusted Logistic Regression Models of Comorbidity and Healthcare Provider Advised Lifestyle Modification in the US Adults 20-64 Years, NHANES 2011-2016**a,b |
|  | **Exercise** | **Reduce fat/calories** | **Control/lose weight** | **All of above** |
| **Comorbidity** | **BMI <25 kg/m2** |
| Free of chronic disease | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| One | 1.8 | (1.3 to | 2.5) | 3.6 | (2.1 to | 6.3) | 1.2 | (0.6 to | 2.2) | 1.2 | (0.4 to | 3.4) |
| Two or more | 3.9 | (2.5 to | 6.1) | 8.3 | (5.1 to | 13.5) | 5.0 | (2.5 to | 10.1) | 3.9 | (1.5 to | 9.8) |
| *P* for trend | <.001 |   | <.001 |   | <.001 |   |   | 0.001 |   |
|  | **BMI 25 - 29.9 kg/m2** |
| Free of chronic disease | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| One | 1.9 | (1.5 to | 2.5) | 3.4 | (2.4 to | 4.7) | 2.3 | (1.6 to | 3.1) | 3.6 | (2.2 to | 6.0) |
| Two or more | 4.4 | (3.2 to | 6.0) | 8.9 | (6.5 to | 12.0) | 4.2 | (3.1 to | 5.6) | 8.0 | (5.0 to | 12.7) |
| *P* for trend | <.001 |   | <.001 |   | <.001 |   |   | <.001 |   |
|  | **BMI ≥30 kg/m2** |
| Free of chronic disease | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |
| One | 1.7 | (1.4 to | 2.0) | 1.7 | (1.3 to | 2.1) | 1.6 | (1.3 to | 1.9) | 1.6 | (1.3 to | 2.1) |
| Two or more | 4.0 | (3.0 to | 5.4) | 4.3 | (3.3 to | 5.4) | 3.8 | (3.0 to | 4.9) | 4.4 | (3.5 to | 5.7) |
| *P* for trend | <.001 |   | <.001 |   | <.001 |   |   | <.001 |   |
| a All estimates were weighted to be nationally representative.b OR adjusted for age (continues), gender, race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian, others), household income, health insurance status, leisure time physical activity, education level, and smoking status |

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| **Table 4. Weighted Multivariable Adjusted Logistic Regression Models of US adults 20-64 Years Receiving Healthcare Providers’ Advice on Lifestyle Modification, NHANES 2011-2016**a |
|  | **Exercise** | **Reduce fat/calories** | **Control/lose weight** | **All of above** |
| **Chronic condition** |  |  |  |  |  |  |  |  |
|  Free or chronic condition | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  |
| High blood pressure | 1.9 | (1.6 to | 2.3) | 2.1 | (1.7 to | 2.6) | 2.0 | (1.6 to | 2.5) | 2.3 | (1.8 to | 2.8) |
| High blood cholesterol | 2.1 | (1.8 to | 2.4) | 3.1 | (2.6 to | 3.7) | 2.1 | (1.8 to | 2.5) | 2.6 | (2.1 to | 3.2) |
| Osteoarthritis | 3.2 | (2.4 to | 4.3) | 4.2 | (3.3 to | 5.3) | 3.2 | (2.5 to | 4.1) | 4.0 | (3.1 to | 5.1) |
| Coronary heart disease | 4.4 | (2.9 to | 6.7) | 5.7 | (4.0 to | 8.0) | 3.0 | (2.3 to | 4.1) | 3.8 | (2.8 to | 5.1) |
| Type 2 diabetes mellitus | 8.2 | (5.9 to | 11.4) | 10.0 | (7.5 to | 13.4) | 10.0 | (7.0 to | 14.1) | 10.1 | (7.5 to | 13.7) |
| **Age** | 1.0 | (1.0 to | 1.0) | 1.0 | (1.0 to | 1.0) | 1.0 | (1.0 to | 1.0) | 1.0 | (1.0 to | 1.0) |
| **Gender** |  |  |  |  |  |  |  |  |  |  |  |  |
| Men | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  |
| Women | 1.7 | (1.5 to | 2.0) | 1.4 | (1.2 to | 1.6) | 1.7 | (1.4 to | 1.9) | 1.6 | (1.3 to | 1.8) |
| **BMI** |  |  |  |  |  |  |  |  |  |  |  |  |
| < 25 kg/m2 | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  |
| 25 - 29.9 kg/m2 | 2.4 | (2.0 to | 2.8) | 3.5 | (2.8 to | 4.5) | 6.1 | (4.3 to | 8.7) | 6.7 | (4.3 to | 10.4) |
| ≥ 30 kg/m2 | 5.8 | (4.9 to | 6.8) | 10.2 | (7.8 to | 13.3) | 28.0 | (20.0 to | 39.2) | 26.6 | (16.1 to | 44.1) |
| **Race/ethnicity** |  |  |  |  |  |  |  |  |  |  |  |  |
| Non-Hispanic white | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  |
| Non-Hispanic black | 1.4 | (1.2 to | 1.6) | 1.6 | (1.4 to | 2.0) | 1.3 | (1.1 to | 1.6) | 1.5 | (1.3 to | 1.9) |
| Hispanic | 1.7 | (1.4 to | 2.1) | 2.0 | (1.7 to | 2.4) | 1.6 | (1.3 to | 1.9) | 2.0 | (1.7 to | 2.4) |
| Asian | 1.9 | (1.6 to | 2.3) | 2.1 | (1.7 to | 2.6) | 1.5 | (1.2 to | 1.9) | 1.7 | (1.3 to | 2.2) |
| Other | 1.2 | (0.9 to | 1.7) | 1.5 | (1.1 to | 2.1) | 1.3 | (0.9 to | 1.8) | 1.7 | (1.2 to | 2.4) |
| **Annual household income**  |  |  |  |  |  |  |  |  |  |  |  |  |
|  <$25,000 | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  |
|  $25,000-<$75,000 | 1.1 | (0.9 to | 1.3) | 1.0 | (0.8 to | 1.2) | 1.0 | (0.8 to | 1.2) | 1.0 | (0.8 to | 1.2) |
|  ≥$75,000 | 1.3 | (1.0 to | 1.5) | 1.1 | (0.9 to | 1.4) | 1.2 | (1.0 to | 1.5) | 1.2 | (1.0 to | 1.5) |
| **Health insurance status** |  |  |  |  |  |  |  |  |  |  |  |  |
| Uninsured | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  |
| Non-private insurance | 1.7 | (1.4 to | 2.0) | 1.5 | (1.2 to | 1.8) | 1.8 | (1.5 to | 2.2) | 1.4 | (1.1 to | 1.8) |
| Private insurance | 1.7 | (1.4 to | 2.1) | 1.7 | (1.4 to | 2.0) | 1.9 | (1.5 to | 2.3) | 1.7 | (1.4 to | 2.1) |
| **Leisure time physical activity** |  |  |  |  |  |  |  |  |  |  |  |  |
| Inactive | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  |
| Insufficient active | 1.2 | (1.0 to | 1.4) | 1.2 | (1.0 to | 1.5) | 1.2 | (1.0 to | 1.4) | 1.3 | (1.0 to | 1.6) |
| Sufficiently active | 0.8 | (0.7 to | 0.9) | 1.0 | (0.8 to | 1.3) | 1.0 | (0.8 to | 1.2) | 1.0 | (0.8 to | 1.3) |
| **Education** |  |  |  |  |  |  |  |  |  |  |  |  |
|  <High school | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  |
|  High school | 1.2 | (1.0 to | 1.4) | 0.9 | (0.7 to | 1.1) | 1.0 | (0.8 to | 1.3) | 1.1 | (0.8 to | 1.4) |
|  >High school | 1.4 | (1.1 to | 1.7) | 0.9 | (0.7 to | 1.1) | 1.2 | (1.0 to | 1.5) | 1.2 | (1.0 to | 1.5) |
| **Smoking status**  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Never | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  | 1 [Reference] |  |
|  Former | 1.3 | (1.1 to | 1.5) | 1.1 | (0.9 to | 1.3) | 1.1 | (0.9 to | 1.3) | 1.1 | (0.9 to | 1.4) |
|  Current | 1.2 | (1.0 to | 1.4) | 1.0 | (0.7 to | 1.2) | 0.9 | (0.8 to | 1.1) | 0.9 | (0.7 to | 1.2) |
| a All estimates were weighted to be nationally representative.  |

**Figure 1. Weighted Prevalence of Healthcare Providers’ Advice on Lifestyle Modification According to Chronic Condition in US Adults 20-64 Years Old, NHANES 2011-2016**a

 a All estimates were weighted to be nationally representative.

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| **Supplement table: Weighted Proportion (%) of US Adults 20-64 Years Current not Receiving Any Lifestyle Advice (exercise, reduce fat/calories, and control/lose weight), NHANES 2011-2016**a |
|   | **BMI 18.5 - <25 kg/m2** |  | **BMI 25 - <30 kg/m2** |  | **BMI ≥30 kg/m2** |  |
| **Free of chronic disease** | 89.1 | (87.2 to | 90.7) |   | 78.6 | (75.7 to | 81.3) |   | 55.8 | (52.6 to | 59.0) |  |
| **High blood pressure** | 71.6 | (67.2 to | 75.6) |   | 55.5 | (50.7 to | 60.2) |   | 27.8 | (25.1 to | 30.6) |  |
| **High blood cholesterol** | 68.8 | (63.5 to | 73.7) |   | 52.6 | (48.0 to | 57.2) |   | 30.0 | (27.0 to | 33.3) |  |
| **Osteoarthritis** | 67.8 | (56.4 to | 77.5) |   | 47.1 | (37.2 to | 57.2) |   | 21.4 | (17.4 to | 26.1) |  |
| **Coronary heart disease** | 59.0 | (44.2 to | 72.4) |   | 32.8 | (23.8 to | 43.3) |   | 19.0 | (13.7 to | 25.6) |  |
| **Type 2 diabetes mellitus** | 36.3 | (23.9 to | 50.9) |   | 34.9 | (26.0 to | 45.0) |   | 9.1 | (5.8 to | 13.8) |  |

a All estimates were weighted to be nationally representative.