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Illicit Drug Use and Cardiometabolic Disease Risk: An Analysis of 2005-2008 National Health and Nutrition Examination Survey Data

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Abstract

Purpose—To explore the association between illicit drug use and cardiometabolic disease risk factors (CDRF) in a nationally representative sample of adults.

Methods—The 2005-2008 National Health and Nutrition Examination Surveys data from 20- to 45-year-old adults (N=8,738) was utilized to analyze the relationship between illicit drug use (ever used, repeated use, and current use) and CDRF (hyperlipidemia, hyperinsulinemia, hypertension, elevated C-reactive protein, body mass index, waist circumference, and cigarette use) via chi square and logistic regression analyses. Age, gender, race/ethnicity, education level, poverty to income ratio (PIR), and alcohol use were included as confounders in the models.

Results—Individuals who reported drug use at least once in lifetime (DU) were more likely to have CDRF than non-DU (NDU) (OR=1.3, p=0.004). Females with DU, illicit drug use at least once in lifetime (IDU), and with repeated illicit drug use (RDU) were about 1.5 times more likely than their non-DU counterparts to have CDRF (p<0.0001, p=0.02, p=0.02, respectively).

Conclusion—Results from this study suggest that healthcare professionals should be aware that patients with a history of DU may be at heightened risk for cardiometabolic disease. Females in particular have a heightened cluster of CDRF across drug-use categories.

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No Conflicts of Interest to Report

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Keywords

cardiometabolic disease risk; drug use; drugs of abuse; adult; minority; women; NHANES; CDC; Center for Disease Control and Prevention

Introduction

Illicit drug use, heart disease, and diabetes are major public health problems in the United States (US) and their prevalence rates continue to rise.[5,6] In 2010, approximately 22.6 million Americans reported current illicit drug use, including marijuana, heroin, cocaine, crack, hallucinogens, inhalants, or non-medical use of prescription-type psychotherapeutics.[5] Alarming, there were about 4.6 million drug-related hospital emergency room visits in 2009, of which 21.2% involved illicit drugs and 80.9% included patients greater than 21 years of age.[7] Concurrently, 1 in 3 adults in the United States live with at least one type of cardiovascular disease[8] and about 81.5 million have pre-diabetes.[6] The World Health Organization estimates that the 82% of the United States population will be overweight (BMI ≥ 25 kg/m²) by the year 2015.[9]

Moreover, ethnic minority groups are consistently disproportionately affected by the high prevalence rates of the aforementioned public health concerns. According to the National Survey on Drug Use and Health, the majority of current illicit drug users are adults aged 26 or older, with males having a higher rate of current drug use than females.[5] Non-Hispanic Blacks reported the highest past-month illicit drug use and had the highest increase of reported use from 2009 to 2010 among major ethnic groups.[5] Furthermore, Non-Hispanic Blacks have a 37% higher age-adjusted death rate for cardiovascular disease versus Non-Hispanic Whites and the highest prevalence rate of diabetes versus other ethnic groups.[6] While studies have identified associations between illicit drug use and adverse mental health outcomes,[10-12] there is a gap in the literature regarding the potential effects and intersection of illicit drug use on cardiometabolic disease risk factors (CDRF) such as elevated weight, lipids, blood pressure, and glucose in adults. Cardiovascular complications among illicit drug users have been noted, but primarily among emergency room patients.[1] For example, studies have acknowledged associations between cocaine and respiratory complications,[13] stroke,[14] acute myocardial infarction,[14,15] and other cardiovascular effects;[16] while methamphetamine use has been linked to elevated risk of cardiac pathology.[17] Similarities between drug addiction and chronic conditions such as obesity have been broached;[18-20] however, the relationship between illicit drug use and CDRF has not been thoroughly examined. In fact, the role of overall nutrition in drug abuse has not been well studied.[3,4] The objective of this study was to determine the association between illicit drug use and CDRF in a national representative, population-based sample of adults living in the US. We hypothesized that illicit drug use would be associated with cardiometabolic disease risk factors in this population.

Methods

Study Population

Participant data from the National Health and Nutrition Examination Survey (NHANES) were analyzed. NHANES uses a stratified, multistage probability cluster sampling design to obtain a nationally representative sample of the non-institutionalized, civilian United States population and has been described in detail elsewhere.[21] Questionnaire data were obtained from an in-home interview; physical and laboratory examinations were conducted in a mobile examination center.[21] All patients provided informed consent and protocols were approved by the National Center for Health Statistics Institutional Review Board.

To increase sample size and statistical reliability, two survey periods (2005-2006 and 2007-2008) were combined into a single data set as recommended by the National Center for Health Statistics.[22] Eligible participants (N = 8738), were 20- to 45-year-old adults who completed the interview and examination. Adults who self-reported diabetes, taking medication for high blood pressure and/or insulin (n=535), and women who self-reported and/or tested positive via urine test as pregnant (n=775) were excluded from the analysis.

Study Variables

NHANES self-report demographic, alcohol use, blood pressure and cholesterol, diabetes, drug, cigarette and tobacco use data files were merged with laboratory and physical measurement data that included the following CDRF: C-reactive protein level (CRP), fasting glucose (GLU), insulin (INS), high-density-lipoprotein cholesterol (HDL), low-density-lipoprotein cholesterol (LDL), total cholesterol (TC), triglycerides (TGL), serum cotinine (Cot), systolic (SBP) and diastolic blood pressure (DBP), and anthropometrics (weight, height, body mass index [BMI], and waist circumference [WC]). Detailed protocol, standardization, and reliability of data collection information and procedures are described elsewhere. [23-25]

Cardiometabolic Disease Risk

The primary outcome of interest was elevated CDRF, defined as the presence of a cluster of three or more abnormal/elevated cardiometabolic risk factors.[26][27] Standardized cut-off values for the CDRF (CRP, GLU, INS, HDL, LDL, TC, TGL, BMI, WC, SBP, DBP) were defined by the criteria set forth by the International Diabetes Federation[28] and the National Heart, Lung, and Blood Institute's Third Report of the National Cholesterol Education Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. [29] Current smoking status was also considered a risk factor based on the American Diabetes Association [26] and American Heart Association [30] guidelines. Current smoking status was measured via serum cotinine levels >3 ng/mL based on optimal cut-off values determined by Benowitz et al.[31] The NHANES Serum Cotinine Data Documentation, Codebook and Frequencies describes serum cotinine as a measure of "the prevalence and extent of tobacco use" [32] and it has been identified as a useful biomarker for determining smoking status [33] Abnormal/elevated cut-off values for the remaining CDRF were as follows: CRP 0.5 mg/dL, TC 240 mg/dL, LDL 100 mg/dL, HDL <50 mg/dL for males, HDL 40 mg/dL for females, TGL > 150 mg/dL, GLU 100 mg/dL, WC 94 cm (37 in) for males, WC 80 cm (31.5 in) for females, INS 9 uU/mL, BMI 25 kg/m², SBP 130 mmHg, and DBP 85 mmHg.

Drug Use

Individual drug use data were compiled from Drug Use questionnaires [34,35] to obtain frequencies of use stratified by specific drug (marijuana, cocaine, methamphetamines, or heroin). The exposure was categorized into the following four dichotomous groups (Yes/No); (1) drug use (DU), defined as a self-report of ever using marijuana, cocaine, methamphetamines, or heroin in the participant's lifetime; (2) illicit drug use (IDU), defined as a self-report of ever using cocaine, methamphetamines, or heroin in the participant's lifetime; (3) repeated drug use (RDU), defined as a self-report of ever using cocaine, methamphetamines, or heroin more than 2-5 times in the participant's lifetime (based on available categorical responses provided by NHANES); and (4) current drug use (CDU), defined as a self-report of using cocaine, methamphetamines, or heroin in the past 30 days. The difference between the DU and IDU categories is the exclusion of marijuana from IDU. Although marijuana is considered an illicit drug, two different categories were created to evaluate potential differences in the association since more than half of the sample reported marijuana use at least once in their lifetime. Participants who reported no use of marijuana,

cocaine, methamphetamines, or heroin in their lifetime were placed in the no drug use category (NDU), which constituted the reference group for the analyses.

Covariates

Age in years, gender, race/ethnicity, education level, poverty to income ratio (PIR), and alcohol use were considered covariates. Race/ethnicity is defined by NHANES as Non-Hispanic White, Non-Hispanic Black, Mexican American, Other Hispanic and Other. For the purposes of the current study, Mexican American and Other Hispanic categories were combined to create a 'Hispanic' classification. Education level was defined as the highest grade or level of education completed and classified as less than 9th grade, 9-11th grade, high school graduate/GED, some college or associate degree, and college graduate or higher. [21,23] PIR is an index variable used to classify socioeconomic status and is calculated by dividing family income by the poverty guidelines, specific to family size, year and state. [21,23] Alcohol use was defined as a self-report of consuming at least 12 drinks in the past year and was based on available categorical responses provided by NHANES.

Statistical Analysis

All statistical analyses were completed using Statistical Analytic Software (SAS) version 9.2 (SAS Institute, Inc., Cary, North Carolina). Survey design analysis methods were implemented to ensure subsample weights, clusters and strata were taken into account. Two domains were created based on subpopulations that completed the interview and measurements in order to analyze the results (1) within the overall sample of 20- to 45-year-old adults, and (2) within male and female subgroups.

Survey frequencies were used to obtain demographic descriptive characteristics (N, Weighted N, Percent and 95% CI) of the study sample. The Survey Means (PROC SURVEYMEANS) procedure was used to obtain descriptive characteristics of anthropometric measurements for each drug (n, mean, and 95% CI). Indicator variables were created for DU, IDU, RDU, and CDU to compare means to NDU using the Survey Reg (PROC SURVEYREG) procedures. Chi-square analysis was used to test the statistical association and a p-value of less than 0.05 was considered statistically significant.

Regression models were fitted with each cardiometabolic disease risk factor independently as the primary outcome. Adjustments were made in a step-wise procedure resulting in a model: age, gender, ethnicity, education level, PIR, and alcohol consumption. Adjusted odds ratios were reported with corresponding 95% confidence intervals and p-values with an alpha set to 0.05. Models were created for each of the four drug use categories of interest, i.e., DU, IDU, RDU, and CDU. Gender-specific logistic regression models were created via domain analysis. All steps were repeated with the exception of including gender as a covariate.

Logistic regression models were fitted with CDRF (a cluster of 3 or more individual risk factors) as the primary categorical outcome. Adjustments were made in a step-wise procedure and yielded a model including age, gender, ethnicity, education level, PIR and alcohol consumption. After adjusting for confounders with the multivariate logistic regression, odds ratios were reported with their corresponding 95% confidence intervals and p-values. Models were created for each of the four drug use categories of interest and gender-specific logistic regression models were created via domain analysis. All steps were repeated with the exception of including gender as a covariate. Male/female interactions were tested using contrasts within logistic regression.

Results

Participant Characteristics

Demographic characteristics of the sample (N=8738, weighted N=199,270,681) are presented in Table 1. More than half (57.4%) of the sample reported drug use at least once in their lifetime. (Table 2) Twenty percent (19.9%) reported use of cocaine, methamphetamine, and/or heroin ('Illicit Drugs') in their lifetime. Overall, significantly more males than females reported drug use. Specifically, 69.3% of males reported ever using a drug compared to 57.9% of women ($p<0.0001$). Significantly more males than females reported current illicit drug use ($p=0.002$), consumed at least 12 alcoholic beverages a year ($p=0.01$), smoked at least 100 cigarettes in lifetime ($p=0.01$), and had a serum cotinine level >3 ng/mL ($p<0.0001$).

Individual CDRF and Drug Use

Mean BMI and WC were elevated for all drug use as well as the no drug use categories (Table 3). Mean BMI in both males and females qualified as "overweight" ($\text{BMI} > 25 \text{ kg/m}^2$) for all groups and met the (abnormal) BMI criterion for metabolic syndrome. Additionally, LDL and INS values were elevated in all drug use categories. The mean SBP in females was significantly elevated versus NDU for the DU, IDU, and RDU (all $p<0.05$) groups. Mean TGL was significantly higher in CDU females than NDU ($p<0.05$). Mean CRP was higher in CDU females than NDU (0.71 mg/dL vs. 0.39 mg/dL, respectively). Compared to the mean Cot value in the NDU group, mean Cot values were statistically higher across all drug use categories in both genders ($p<0.0001$).

Although both males and females presented with elevated WC, CDU females had the highest value (99.2 cm/39.1 in) which was almost 20 cm above the standardized cut-off value[29] and significantly higher than NDU ($p=0.03$). NDU males presented with the highest WC (99.7 cm/39.3 in) among the drug use categories; however, all categories presented with means significantly lower than those in the NDU males (all $p<0.05$). HDL mean values in males were significantly higher across all drug use categories compared to NDU (all $p<0.05$). Only CDU females had a statistically significant lower mean HDL versus NDU ($p=0.04$).

Fifty-five percent (55%) of our overall sample presented with a cluster of ≥ 3 CDRF. Sixty one percent (61%) of participants who reported DU presented with a cluster of ≥ 3 CDRF. Prevalence of each CDRF factor and a cluster of ≥ 3 CDRF within the overall sample by drug use category is shown in Table 4. Elevated WC and SBP were significantly associated with DU, IDU, and RDU groups ($p<0.04$ for all). Elevated DBP was associated with DU, IDU, RDU and CDU ($p<0.04$ for all). An association was found between DU and abnormal/elevated INS ($p=0.005$). Elevated TC was significantly associated with IDU and RDU groups ($p<0.04$). Significant unadjusted associations between CDRF and DU ($\chi^2=10.1$, $p=0.002$), IDU ($\chi^2=8.8$, $p=0.003$), and RDU ($\chi^2=8.6$, $p=0.003$) were also found.

Predictors of CDRF for Drug Use Groups

Logistic regression analysis adjusted for age, gender, race/ethnicity, education level, PIR, and alcohol consumption confirmed that adults with DU at least once in lifetime were significantly more likely to have CDRF than non-DU adults (AOR=1.3, $p=0.004$). Regression models for CDRF and IDU, RDU, and CDU in the entire sample were not significant ($p=0.30$, $p=0.31$, and $p=0.92$, respectively).

Gender-specific logistic regression analysis controlling for aforementioned covariates showed that females within all drug categories except CDU were at significantly increased

odds of presenting with CDRF than the females in the NDU group (DU: $p<0.0001$, IDU: $p=0.02$, RDU: $p=0.02$). (Table 3a) After testing the interaction between gender and drug categories, DU females were more likely to have CDRF than males. Regression on individual CDRF revealed that females across all drug use categories were more likely to have elevated DBP than NDU (all $p=0.02$). CDU females were 6.13 times more likely than NDU to have elevated SBP ($p<0.0001$) and 2.8 times more likely than NDU to have elevated TGL levels ($p=0.03$). DU, IDU and RDU males were less likely to have elevated WC, BMI, GLU, and INS levels than NDU (all $p=0.03$). Stratified by ethnicity, an association between drug use and CDRF was only found in those who reported drug use at least once in their lifetime. Non-Hispanic Blacks with DU had at least 1.5 times greater odds ($p=0.005$) of having CDRF than their non-drug-using counterparts.

Discussion

Results here show that drug use at least once in lifetime is associated with a cluster of 3 CDRF in 20- to 45-year-old adults. Over 60% of participants with reported DU, IDU, RDU, and CDU had a BMI ≥ 25 kg/m², elevated WC, and elevated LDL values. Analysis also showed that DU, IDU, and RDU females and DU Non-Hispanic Blacks are at higher risk for elevated CDRF than their non-drug-using counterparts. All drug use categories showed elevated mean values for BMI, WC, LDL, and INS compared to standardized cut-off values. These findings suggest that there are significant proportions of the US adult population in poor cardiometabolic health, even in early to mid-adulthood.

While there is literature that describes illicit drug users as underweight, or malnourished, [36,37] our findings coincide with the implications of studies that have examined the high sugar and processed food intake of heroin users.[2,38] Neale et. al. found that heroin users ate infrequently, but when they did eat, they often consumed quick, cheap, easy to access, and sweet foods that were not prepared by themselves.[2] In addition, a longitudinal medicolegal study by Rajs et al.[39] found that that prevalence of overweight illicit drug users is increasing in Sweden.

Indeed, our findings imply that our classic “picture” of the health of a drug user may no longer be accurate in light of the current obesity epidemic. Instead, results from this study suggest that healthcare professionals should be aware that patients with a history of DU may be faced with not only addiction but heightened risk for cardiometabolic disease. Existing literature suggests that illicit drug users are not only at higher risk for medical complications but they do not receive primary care less often than NDU[40,41]. Most of their health care utilization is via emergency departments of hospitals; [42,43]therefore, if a patient reports a history of drug use, clinicians may consider screening for cardiometabolic disease risk factors if the patient has not have record of such tests.

A previous NHANES analysis found an association between regular cocaine use and nonfatal myocardial infarction and stroke;[14] however, the study did not examine anthropometric or metabolic measures or non-regular use. Due to the immediate effects of illicit drugs and high reports of “experimenting”, it is equally relevant to examine the effects of short term or non-regular use. This need is illustrated by the high prevalence of drug use once in lifetime in our findings coupled with the higher odds of elevated CDRF compared to the non-drug use group within our sample.

The gender difference in the association between drug category and a cluster of 3 CDRF is of particular interest. There was no statistically significant difference found in males in any drug use category, but females in all drug categories except current use were at higher odds of being at risk for cardiometabolic disease versus females with no history of drug use. This

suggests that the experimentation of a drug at least once in a lifetime may be of greater risk in females than in males when compared to their respective counterparts. Other studies [44,45] have examined gender-specific relationships between BMI and substance use, but not specific CDRF as was done here. Future studies should further examine this phenomenon.

Limitations

Definitions of drug use categories were based on the data available from NHANES. For example, repeated illicit drug use was defined as a self-report of ever using cocaine, methamphetamines, or heroin more than 2-5 times. Future studies may consider incorporating a more stringent definition for this drug use category. In addition, while a statistically significant association between current cocaine, heroin, and methamphetamine use and CDRF was not found in the present analysis of 2005-2008 NHANES, it may be attributed to the low number of participants in our sample with reports of current use which may be an artifact of the study design (door-to-door sampling). Response rates for the two cycles used for the current study ranged from 81.2 % for the interview (20-29 year olds) to 72.4% for the examination (40-49 year olds).[46,47] Other authors have identified this as a problem as epidemiologic studies such as the present one rarely include significant numbers of individuals with current drug use or drug use disorders, an issue that must be taken into consideration in any future study examining the relationship between drug use and cardiometabolic disease risk.[44]

Causality cannot be inferred in a cross-sectional study since the exposure and outcome are collected simultaneously. Systematic bias is a possibility since drug and alcohol use was self-reported. Due to the nature of exposure, it may have been underreported. Finally, genetic, physical activity, and dietary intake influences were not examined. Future studies should closely examine dietary habits and the potential impact of DU on CDRF in adults.

Conclusion

Given the high prevalence of illicit DU and CDRF in the US, our results contribute preliminary evidence suggesting an association between drug use and CDRF which in turn may place individuals with a history of drug use at an increased risk for cardiovascular disease and type two diabetes mellitus. Due to the cross-sectional nature of our study, causality cannot be confirmed; however, findings suggest the need to potentially consider more than weight when analyzing the health of adults who report a history of drug use. Published prospective data on illicit drug use and diabetes is limited; therefore, our preliminary population-based findings could support longitudinal cohort studies focused on following drug users over time to explore the incidence of individual and clustered cardiometabolic disease risk factors as well as overt diabetes and cardiovascular disease.

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List of Abbreviations

NHANES	National Health and Nutrition Examination Survey
CDRF	Cardiometabolic disease risk factors
DU	Drug use at least once in lifetime
IDU	Illicit drug use at least once in lifetime
RDU	Repeated illicit drug use
CDU	Current illicit drug use
NDU	No drug use
CRP	C-reactive protein level
GLU	Fasting glucose
INS	Insulin
HDL	High-density-lipoprotein cholesterol
LDL	Low-density-lipoprotein cholesterol
TC	Total cholesterol
TGL	Triglycerides
Cot	Serum cotinine
SBP	Systolic blood pressure
DBP	Diastolic blood pressure
BMI	Body mass index
WC	Waist circumference

What's Known?

Cardiovascular complications among cocaine, methamphetamine, and heroin users have been noted among emergency room patients.[1] While heroin users have been found to consume quick, cheap, easy to access, and sweet foods that are not prepared by themselves,[2] cardiometabolic disease and the role of overall nutrition in drug abuse has not been well studied.[3,4]

What's New?

DU is associated with having a cluster of 3 CDRF in 20- to 45-year-olds. There was no statistically significant difference found in males in any drug use category, but females in all categories except current use were at higher odds of being at risk for cardiometabolic disease versus NDU females, suggesting that drug experimentation may be of greater risk in females than males when compared to their respective counterparts.

Table 1

Demographic Characteristics and Drug Use among 20-to-45 Year Olds, National Health and Nutrition Examination Surveys, 2005-2008 (N=8738).

	n	Weighted n	Percent (95% CI)
<i>Gender</i>			
Male	4420	100,206,825	50.3 (48.8-51.8)
Female	4318	99,063,856	49.7 (48.2-51.2)
Total	8738	199,270,681	100.0
<i>Ethnicity</i>			
Hispanic	2,734	33,189,231	16.7 (13.4-19.9)
Non-Hispanic Black	1,952	24,828,212	12.5 (9.8-15.2)
Non-Hispanic White	3,636	128,584,616	64.5 (59.5-69.6)
Other	416	12,668,623	6.3 (4.9-7.8)
<i>Education Level</i>			
Less than 9 th Grade	742	10,386,452	5.2 (4.1-6.3)
9-11 th Grade	1528	25,664,093	12.9 (10.9-14.9)
High School diploma/GED	2114	47,772,557	24.0 (21.9-26.1)
Some College or AA degree	2676	64,948,919	32.6 (30.9-34.4)
College Graduate or above	1675	50,353,092	25.3 (21.8-28.8)
<i>Annual Family Income</i>			
>\$15,000	852	15,907,447	16.6 (14.3-18.9)
\$20,000 - \$34,999	872	17,903,885	18.7 (16.0-21.3)
\$35,000 - \$54,999	838	20,658,451	21.5 (18.5-24.5)
\$55,000 - \$74,999	488	14,406,554	15.0 (11.9-18.2)
> \$75,000	854	27,121,791	28.3 (23.9-32.6)

Table 2

Drug and Alcohol Use among 20- to 45- Year-Olds, National Health and Nutrition Examination Surveys, 2005-2008 (N=8738).

Drug Use	Overall (N=8,738)			Males (n=4420)			Females (n=4318)		
	n	Weighted n	%	n	Weighted n	%	n	Weighted n	%
Ever used drug ⁺	4558	114,342,681	57.4	2620	63,155,698	69.3	1938	51,186,983	57.9
Ever used Cocaine ⁺	1502	38,386,825	19.3	962	23,227,397	23.2	540	15,159,428	15.3
Ever used Methamphetamines ⁺	566	15,384,115	7.7	354	9,567,757	9.5	212	5,816,358	5.9
Ever used Heroin ⁺⁺	164	4,235,398	2.1	108	2,792,907	2.8	56	1,442,491	1.5
Ever used Marijuana ⁺	4454	112,962,153	56.7	2540	62,002,926	61.9	1914	50,959,227	51.4
Ever used Illicit Drug ⁺	1568	39,701,020	19.9	998	23,841,632	26.2	570	15,859,388	18.0
Current MJ use ⁺	1140	27,125,751	13.6	782	18,325,850	18.3	358	8,799,901	8.9
Current Cocaine use ⁺⁺	122	2,452,649	1.2	88	1,656,595	1.7	34	796,054	0.8
Current Methamphetamine use	36	1,006,371	0.5	22	531,814	0.5	14	474,556	0.5
Current Heroin use	16	370,388	0.2	8	168,428	0.2	8	201,961	0.2
Current Illicit Use ⁺⁺⁺	232	4,969,066	2.8	162	3,205,840	3.6	70	1,763,227	2.0
At least 12 drinks last year ⁺⁺	5914	143,260,207	78.8	3392	78,858,646	85.5	2522	64,401,561	71.9

⁺ Difference between males and females p<0.001

⁺⁺ Difference between males and females p=0.01

⁺⁺⁺ Difference between males and females p=0.002

Table 3

Estimates of Mean Cardiometabolic Disease Risk Factor Values among 20- to 45- Year Olds, National Health and Nutrition Examination Surveys, 2005-2008.

Cardiometabolic Disease Risk Factor	Drug (Ever Use) Mean (95%CI)	Illicit Drug (Ever Use) Mean (95%CI)	Illicit Drug (>2-5 times) Mean (95%CI)	Current Illicit Drug (>2-5 times) Mean (95% CI)	Drug (No Use) Mean (95%CI)
Waist Circumference, cm					
<i>Males</i>	97.1 (96.0-98.3)*	96.1 (94.5-97.7)*	96.3 (94.6-98)*	93.3 (30.4-96.2)*	99.7 (98.2-101.2)
<i>Females</i>	92.2 (90.5-94.0)	93.2 (90.6-95.8)	93.2 (90.5-95.8)	99.2 (92.8-105.5)*	91.3 (89.9-92.8)
Body Mass Index, kg/m ²					
<i>Males</i>	28.0 (27.5-28.4)*	27.4 (26.8-27.9)*	27.4 (26.8-27.9)*	26.3 (25.2-27.3)*	29.1 (28.5-29.7)
<i>Females</i>	28.0 (27.4-28.7)	28.1 (27.0-29.2)	28.1 (27.0-29.1)	30.5 (27.3-33.7)*	28.1 (27.4-28.8)
C-Reactive Protein, mg/dL					
<i>Males</i>	0.26 (0.22-0.31)	0.25 (0.20-0.31)	0.25 (0.20-0.31)	0.33 (0.23-0.42)	0.33 (0.27-0.39)
<i>Females</i>	0.46 (0.40-0.53)	0.47 (0.34-0.59)	0.46 (0.34-0.59)	0.71 (0.30-1.10)	0.39 (0.34-0.45)
Total Cholesterol, mg/dL					
<i>Males</i>	193.9 (190.5-197.2)	196.6 (192.1-201.1)	196.6 (192.1-201.1)	201.4 (190.1-212.7)	194.1 (190.6-197.6)
<i>Females</i>	190.3 (186.8-193.8)	192.8 (186.8-198.9)	193.1 (186.9-199.3)	183.9 (176.9-190.8)	188.6 (185.7-191.5)
LDL Cholesterol, mg/dL					
<i>Males</i>	113.1 (109.1-117.2)	113.0 (105.8-120.3)	113.1 (105.8-120.3)	120.8 (104.5-137.1)	114.3 (110.5-118.2)
<i>Females</i>	108.5 (103.8-113.1)	107.2 (99.0-115.4)	107.2 (99.0-115.4)	88.0 (84.7-91.2)*	107.4 (102.9-112.0)
HDL Cholesterol, mg/dL					
<i>Males</i>	47.0 (46.0-48.0)*	47.7 (46.3-49.0)*	48.0 (46.6-49.5)*	49.9 (47.0-52.8)*	44.3 (43.3-45.2)
<i>Females</i>	57.0 (55.2-59.0)	57.7 (55.4-60.1)	57.5 (55.0-60.0)	51.0 (45.5-56.6)*	56.4 (54.9-57.8)
Triglycerides, mg/dL					
<i>Males</i>	152.4 (141.8-163.1)	152.8 (135.9-169.8)	152.8 (135.9-169.8)	138.0 (121.6-154.5)	144.2 (133.3-155.1)
<i>Females</i>	108.4 (99.4-117.4)	109.6 (99.4-119.8)	109.6 (99.4-119.8)	124.8 (89.6-160.0)*	104.5 (95.2-113.9)
Fasting Glucose, mg/dL					
<i>Males</i>	100.2 (98.5-102.0)	101.4 (98.3-104.5)	101.4 (98.3-104.5)	103.7 (96.7-110.7)	103.6 (100.6-106.7)
<i>Females</i>	95.6 (93.8-97.3)	95.9 (93.0-99.0)	96.2 (93.0-99.3)	99.7 (86.9-112.6)	98.5 (95.0-101.9)
Fasting Insulin, uU/mL					

Cardiometabolic Disease Risk Factor	Drug (Ever Use) Mean (95% CI)	Illicit Drug (Ever Use) Mean (95% CI)	Illicit Drug (>2-5 times) Mean (95% CI)	Current Illicit Drug (>2-5 times) Mean (95% CI)	Drug (No Use) Mean (95% CI)
<i>Males</i>	12.7 (11.3-14.1)	11.5 (9.5-13.4)	11.5 (9.5-13.4)	10.9 (6.4-15.4)	13.9 (12.4-15.5)
<i>Females</i>	10.9 (9.6-12.2)	10.7 (7.7-13.6)	10.6 (7.7-13.5)	9.3 (6.6-12.1)	10.9 (10.0-11.9)
Systolic Blood Pressure, mm Hg					
<i>Males</i>	119.6 (118.7-120.6)	120.0 (118.7-121.3)	120.0 (118.7-121.2)	118.6 (115.0-122.2)	119.7 (118.3-121.0)
<i>Females</i>	112.8 (111.8-113.7)*	113.8 (111.3-116.3)	113.9 (111.4-116.4)	116.9 (107.8-126.0)	111.2 (110.2-112.3)
Diastolic Blood Pressure, mm Hg					
<i>Males</i>	71.3 (70.5-72.2)	71.7 (70.4-73.0)	71.7 (70.4-73.0)	70.1 (65.8-74.4)	71.0 (70.0-72.3)
<i>Females</i>	68.8 (67.8-69.9)	69.9 (68.0-71.9)	70.0 (68.0-72.0)	73.5 (67.4-79.7)	68.5 (67.5-69.5)
Serum Cofinine, ng/dL					
<i>Males</i>	117.9 (103.4-132.4)*	133.5 (116.3-150.6)*	133.5 (116.3-150.6)*	162.4 (118.6-206.1)*	42.6 (30.3-50.4)
<i>Females</i>	85.0 (72.2-97.7)*	103.0 (85.2-120.8)*	103.8 (86.0-121.6)*	166.1 (109.2-223.0)*	22.1 (15.8-28.5)

*T-test results statistically significant ($p < 0.05$) for comparisons with NDU group

Table 3a. Regression* on each Cardiometabolic Disease Risk Factor among 20- to 45-Year Olds									
Cardiometabolic Disease Risk Factor	Drug (Ever Use)		Illicit Drug (Ever Use)		Illicit Drug (>2-5 times)		Current Illicit Drug (>2-5 times)		
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	
Waist Circumference, cm									
<i>Males</i>	0.68 (0.55-0.84)	0.0004	0.64 (0.45-0.91)	0.01	0.64 (0.45-0.91)	0.01	0.68 (0.55-0.84)	0.0004	
<i>Females</i>	1.05 (0.78-1.43)	0.74	1.10 (0.76-1.50)	0.71	1.05 (0.75-1.48)	0.76	1.10 (0.77-1.43)	0.74	
Body Mass Index, kg/m²									
<i>Males</i>	0.78 (0.64-0.96)	0.02	0.73 (0.57-0.94)	0.02	0.73 (0.57-0.94)	0.02	0.54 (0.34-0.87)	0.01	
<i>Females</i>	0.96 (0.76-1.21)	0.70	1.00 (0.68-1.46)	0.99	0.98 (0.67-1.44)	0.93	1.30 (0.49-3.44)	0.59	
C-Reactive Protein, mg/dL									
<i>Males</i>	0.83 (0.59-1.17)	0.28	0.85 (0.56-1.30)	0.46	0.85 (0.55-1.30)	0.46	1.40 (0.65-2.93)	0.41	
<i>Females</i>	1.17 (0.85-1.61)	0.33	0.97 (0.67-1.42)	0.89	0.97 (0.66-1.42)	0.87	1.40 (0.49-4.01)	0.53	
Total Cholesterol, mg/dL									
<i>Males</i>	1.30 (0.79-2.14)	0.31	1.30 (0.78-2.14)	0.31	1.25 (0.86-1.81)	0.25	2.60 (1.37-4.96)	0.004	
<i>Females</i>	1.23 (0.81-1.85)	0.32	1.23 (0.82-1.85)	0.32	1.34 (0.81-2.19)	0.25	0.62 (0.12-3.34)	0.58	
LDL Cholesterol, mg/dL									

Table 3a. Regression* on each Cardiometabolic Disease Risk Factor among 20- to 45-Year Olds									
Cardiometabolic Disease Risk Factor		Drug (Ever Use)		Illicit Drug (Ever Use)		Illicit Drug (>2.5 times)		Current Illicit Drug (>2.5 times)	
		OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
<i>Males</i>		0.85 (0.57-1.28)	0.44	1.15 (0.70-1.88)	0.59	1.15 (0.70-1.88)	0.59	2.24 (0.74-6.82)	0.15
<i>Females</i>		1.04 (0.70-1.54)	0.85	0.70 (0.44-1.01)	0.11	0.71 (0.45-1.10)	0.13	0.14 (0.02-1.10)	0.06
HDL Cholesterol, mg/dL									
<i>Males</i>		1.14 (0.84-1.56)	0.38	1.25 (0.91-1.72)	0.17	1.25 (0.91-1.72)	0.17	1.51 (0.90-2.55)	0.12
<i>Females</i>		0.90 (0.72-1.12)	0.33	1.10 (0.74-1.54)	0.72	1.10 (0.75-1.60)	0.64	0.75 (0.40-1.46)	0.40
Triglycerides, mg/dL									
<i>Males</i>		0.93 (0.65-1.32)	0.002	1.10 (0.69-1.61)	0.80	1.10 (0.69-1.61)	0.80	1.05 (0.45-2.43)	0.91
<i>Females</i>		1.23 (0.75-2.01)	0.41	1.44 (0.87-2.39)	0.15	1.50 (0.87-2.5)	0.15	2.80 (1.11-7.03)	0.03
Fasting Glucose, mg/dL									
<i>Males</i>		0.69 (0.49-0.97)	0.03	0.66 (0.50-0.89)	0.005	0.66 (0.50-0.89)	0.005	1.17 (0.59-2.32)	0.66
<i>Females</i>		0.79 (0.54-1.16)	0.23	1.02 (0.55-1.91)	0.95	1.03 (0.55-1.94)	0.92	0.92 (0.11-7.95)	0.94
Fasting Insulin, uU/mL									
<i>Males</i>		0.63 (0.47-0.84)	0.001	0.56 (0.41-0.78)	0.0006	0.56 (0.40-0.78)	0.0006	0.76 (0.26-2.22)	0.62
<i>Females</i>		0.90 (0.67-1.21)	0.50	0.89 (0.53-1.51)	0.67	0.87 (0.52-1.45)	0.59	1.42 (0.53-3.80)	0.49
Systolic Blood Pressure, mm Hg									
<i>Males</i>		1.03 (0.77-1.37)	0.86	1.13 (0.82-1.58)	0.45	1.13 (0.82-1.58)	0.45	0.72 (0.27-1.94)	0.51
<i>Females</i>		2.01 (1.42-2.85)	<0.0001	1.37 (0.91-2.05)	0.13	1.37 (0.92-2.10)	0.13	5.79 (1.24-27.1)	0.03
Diastolic Blood Pressure, mm Hg									
<i>Males</i>		1.06 (0.69-1.61)	0.80	1.26 (0.83-1.92)	0.28	1.26 (0.83-1.92)	0.28	1.60 (0.72-3.56)	0.25
<i>Females</i>		1.78 (1.11-2.85)	0.02	1.89 (1.25-2.86)	0.003	1.90 (1.26-2.78)	0.002	6.13 (2.65-14.2)	<0.0001
Serum Cotinine, ng/dL									
<i>Males</i>		4.54 (3.2-6.4)	<0.0001	2.24 (1.77-2.85)	<0.0001	2.24 (1.78-2.85)	<0.0001	2.93 (1.62-5.30)	0.0004
<i>Females</i>		6.22 (4.90-7.91)	<0.0001	3.26 (2.40-4.43)	<0.0001	3.34 (2.50-4.52)	<0.0001	3.45 (1.65-7.23)	0.001
Cluster of 3 CMDR factors									
<i>Males</i>		1.02 (0.81-1.23)	0.89	0.95 (0.73-1.25)	0.72	0.95 (0.73-1.25)	0.72	0.97 (0.55-1.73)	0.92
<i>Females</i>		1.53 (1.24-1.89)	<0.0001	1.45 (1.10-1.97)	0.02	1.43 (1.10-1.93)	0.02	1.00 (0.52-1.94)	0.99

* controlled for age, ethnicity, gender, education, PIR, Alcohol

Table 4

Prevalence of Abnormal Cardiometabolic Disease Risk Factors among 20- to 45-Year-Olds, by Drug Use Group, National Health and Nutrition Examination Surveys, 2005–2008.

Cardiometabolic Disease Risk Factor	Drug (Ever Use) Mean (95%CI)	Illicit Drug (Ever Use) Mean (95%CI)	Illicit Drug (>2.5 times) Mean (95%CI)	Current Illicit Drug (>2.5 times) Mean (95% CI)	Drug (No Use) Mean (95%CI)
Body Mass Index, kg/m ²	2940 (62.5)	996 (62.8)	992 (62.6)	136 (60.7)	2182 (64.5)
Waist Circumference, cm *	2808 (62.6) *	938 (60.7) *	934 (60.5) *	128 (60.5)	2198 (68.7)
C-Reactive Protein, mg/dL	840 (18.5)	276 (17.4)	274 (17.3)	50 (23.5)	662 (20.3)
Total Cholesterol, mg/dL	808 (38.4)	308 (41.3) *	308 (41.4) *	47(40.3)	550 (35.3)
LDL Cholesterol, mg/dL	1206 (60.0)	436 (60.7)	436 (61.0)	68 (63.9)	816 (60.4)
HDL Cholesterol, mg/dL *	797 (37.1)	271 (35.0)	269 (37.8)	38 (38.2)	612 (39.7)
Triglycerides, mg/dL	552 (27.0)	218 (29.7)	218 (29.8)	32 (36.0)	346 (24.5)
Fasting Glucose, mg/dL	672 (32.4)	244 (31.7)	244 (31.7)	42 (43.7)	650 (37.0)
Fasting Insulin, uU/mL	854 (41.8) *	284 (38.9)	284 (38.9)	40 (45.9)	686 (48.6)
Systolic Blood Pressure, mm Hg	536 (11.4) *	196 (12.9) *	196 (13.0) *	22 (10.8)	284 (7.8)
Diastolic Blood Pressure, mm Hg	344 (7.7) *	142 (8.8) *	142 (8.8) *	20 (12.8) *	164 (5.1)
Serum Cotinine 3 ug/dL	2170 (45.7) *	868 (54.6) *	868 (54.6) *	158 (68.0) *	438 (13.5) *
3 Elevated CDRF	2821 (60.9) *	1018 (63.9) *	1014 (63.7) *	146 (62.7)	1811 (55.3) *

* Chi-Square Analysis results statistically significant (p<0.05)