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Three-fold increase in PrEP uptake over time with high adherence among young men who have sex with men in Chicago

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Abstract

The goal of this work is to better understand utilization and uptake of pre-exposure prophylaxis (PrEP) among young men who have sex with men (YMSM) and transgender women (TGW).

We assessed trends and correlates of PrEP use and adherence across three time points of longitudinal data collection among 885 YMSM and TGW (aged 16–29) from the RADAR cohort in Chicago, 2015–2017.

Past six-month PrEP use increased across three visits: from 6.6% to 17.5%. In multivariable models, past six-month PrEP use was significantly associated with participation in condomless sex, having more sexual partners, and older age. At least three-quarters of current PrEP users reported being 90% adherent to PrEP medication across all visits.

Past six-month PrEP use increased over time with those who participated in high-risk HIV behaviors also those most likely to have taken PrEP. As PrEP uptake continues to rise, more research will be needed to understand predictors of PrEP usage, as well as patterns of sexual behavior change following uptake.

INTRODUCTION

Two-thirds of all new HIV diagnoses in the United States (U.S.) occur among men who have sex with men (MSM), a proportion that increased 6% between 2005 and 2014.¹ In 2014, MSM aged 13–24 accounted for one-third of all new diagnoses among gay and bisexual men, with young black MSM experiencing the highest burden of disease.¹ Given the increasing burden of HIV among young MSM (YMSM), understanding how pre-exposure prophylaxis (PrEP) is used in this population outside of clinical trials and demonstration projects is key in order to increase its uptake and to slow the spread of HIV in the U.S.

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PrEP has been shown to be highly effective at preventing acquisition of HIV with up to a 92% reduction in HIV incidence among those with high rates of adherence to the medication.² Despite being shown to be one of the most effective ways of preventing HIV transmission,² PrEP uptake has plateaued, reaching ~35,000 prescriptions nationally in mid-2016³ and ~98,000 during the period from 2012–2016.⁴ Additionally, less than 7% of PrEP prescriptions have gone to men under 25.⁵ To better understand the slow rate of PrEP uptake, several recent studies assessed whether participants were aware of PrEP and whether they had ever used PrEP in their lifetime.^{6–8} Data also indicate differences in PrEP awareness and usage patterns across various groups, including lower rates of each among Black and transgender individuals.^{9,10} These findings suggest that PrEP awareness and use are unevenly distributed across all regions and at-risk populations. Further work is needed to assess the characteristics of individuals who have and who have not used PrEP in order to understand and eventually increase its uptake.

Evidence suggests that some individuals believe they would decrease their use of other HIV risk reduction behaviors (e.g., condoms) if they began taking PrEP. One recent study found that, among high-risk HIV-negative MSM in New York City, nearly 70% reported they would be willing to use PrEP provided it was at least 80% effective at preventing HIV; however, 35% of these same individuals also reported they would likely decrease condom use while on PrEP.¹¹ Decreasing condom use while taking PrEP may be problematic as PrEP effectiveness is largely dependent on adherence to the medication. An individual who is neither adherent to their PrEP medication nor using condoms is likely to be at an increased risk of HIV acquisition. Additionally, PrEP plays no role in preventing the transmission of other sexually transmitted infections, the risk of which may also increase given a decrease in condom use. Together, these findings suggest that while many MSM may be willing to take PrEP, condom use may decrease among some MSM on PrEP. As such, more work needs to be done to understand PrEP adherence in order to optimize its effectiveness.

While there has been a large focus recently on research related to PrEP awareness and knowledge^{6–8,12,13} there has been a relative dearth of research examining trends in PrEP use and characterizing PrEP adherence among HIV at-risk populations, particularly among YMSM and TGW. By examining characteristics of sexual minority PrEP users, we can gain a better understanding of who is more likely to take PrEP and whether PrEP users are more or less likely to participate in other HIV risk reduction behaviors. To address this, we analyzed data from a large cohort of YMSM and transgender women (TGW) in order to: 1) assess baseline demographic characteristics and risk behaviors associated with past six-month PrEP use among a cohort of sexual minority youth (aged 16–29), 2) assess adherence to PrEP medication, and 3) assess longitudinal trends in PrEP use across the three waves of data collection over one year.

METHODS

Study Design & Recruitment

Data were collected as part of RADAR, an ongoing longitudinal cohort study of YMSM and TGW living in the Chicago metropolitan area. The primary objective of this cohort study is

to apply a multilevel perspective¹⁴ to a syndemic of health issues associated with HIV among diverse YMSM and TGW¹⁵. Diverse methods for participant recruitment have been previously described^{16,17} and were selected in order to achieve the multiple cohort, accelerated longitudinal design.¹⁸ Briefly, participants were recruited using a variety of methods including venue based recruiting, social media (e.g. Facebook), and incentivized snow ball sampling. At the time of enrollment into their original respective cohorts, all participants were between 16 and 20 years of age, assigned male at birth, spoke English, and had a sexual encounter with a man in the previous year or identified as gay, bisexual or transgender. Data were collected via a computer-assisted self-interview (CASI). Subjects who were unable to complete in-person interviews (i.e., moved away from Chicago area), select measures were administered online via a remote CASI. Remote participants were retained in the event that the subject returns to Chicago.

The PrEP measures included in these analyses were administered to study participants at baseline, 6- and 12-month follow-up visits between 2015 and 2017. Each visit included HIV testing and counseling for HIV-negative participants. Referrals for PrEP services were provided when requested, consistent with community standards for PrEP referrals during HIV testing and counseling. Participants who self-reported being HIV-positive were not asked questions about PrEP use and were subsequently excluded from all analyses. For the purposes of the regression analyses, we restricted analyses to the baseline sample of HIV-negative participants (N = 885). Study visits 2 and 3 are ongoing, so when examining trends over time in PrEP use, we included only those participants who had completed their first three visits at the time of analysis (n = 472).

Measures

Demographics—Participants were asked to provide demographic information such as age, race/ethnicity, sex assigned at birth, gender identity and sexual orientation at each visit. For purposes of these analyses, participants reporting a Hispanic/Latino ethnicity were coded as such, regardless of their racial identity. Socioeconomic factors were also assessed by asking participants to provide information on both their current level of education as well as their current employment status.

PrEP Use—In this study, we administered two items to assess PrEP usage. Participants were asked whether they had ever used PrEP in their lifetimes and, among those who had, whether they had used PrEP in the past six months.

We also assessed PrEP adherence among current PrEP users, although this question was added in a later version of the survey and not all eligible participants have yet received it. Similar to past research assessing ART adherence, PrEP adherence was assessed via a visual analogue task¹⁹ with participants choosing any value on a sliding scale from zero percent (indicating having never taken PrEP as prescribed) to 100% (indicating having taking PrEP as prescribed every day). Participants also reported the number and timing of missed doses, indicating whether they had missed a dose within the past week, the past month, more than a month ago, or never. Among those who reported missing a dose of PrEP in the past week, participants indicated on which of the past seven days they had missed a dose.

HIV Risk and Substance Use Behaviors—HIV risk behaviors included engagement in condomless sex and the number of sexual partners. Condomless anal sex with male partners was operationalized as either having no instances of condomless sex or having at least one instance of condomless sex. Number of male sexual partners in the past six months was reported and utilized as a count variable. Marijuana use was assessed using an eight-item screen instrument, the Cannabis Use Disorder Identification Test (CUDIT).²⁰ CUDIT scores ranged from 0–32 and were operationalized as a continuous variable with higher scores indicating more hazardous cannabis use. Alcohol use among participants was assessed using the Alcohol Use Disorders Identification Test (AUDIT)²¹ developed by the World Health Organization and was utilized as a continuous variable with higher scores indicating high levels of alcohol problems (possible range from 0–40).

Statistical Analyses

We utilized data from the baseline assessment only (i.e., the full analytic sample; $N = 885$) in order to examine demographic and behavioral correlates of PrEP use. All available data across visits one, two and three were used to characterize PrEP adherence. Pearson's chi-square test statistic was used to determine whether or not demographic characteristics and HIV risk behaviors were independent from PrEP usage. Multivariable logistic regression models were then utilized to examine whether HIV risk behaviors were associated with past six-month PrEP use, while adjusting for demographic characteristics. In this manner we were able to determine which characteristics had a significant association with PrEP use while accounting for differences in demographic characteristics and HIV risk-related behaviors. All covariates identified as statistically significant at the $p = .05$ level, in bivariate analyses using the Wald test statistic, or known confounders were included in the multivariable regression model.

In order to examine trends over time in PrEP use, we used data from only those participants who had completed all three assessments at the time of analysis ($n = 472$). Trends in PrEP use over the past six months and PrEP use at the time of interview were then visualized across the first three waves of data collection. Trends in past six-month PrEP use were stratified by race and ethnicity in order to better understand any differences in uptake over time, particularly in the context of observed differences in risk of HIV acquisition.²² Rate of past six-month PrEP use across the first three visits were assessed utilizing unadjusted Poisson regression. All analyses were performed in Stata v14.1.²³

RESULTS

Sample characteristics

As shown in Table 1, the mean age of participants was 20.8 years (Standard Deviation [SD] = 2.8) with 111 (12.5%) participants < 18 years of age. Among all participants, 259 (29.3%) identified as black, 251 (28.4%) identified as white, 273 (30.8%) identified as Hispanic, and 102 (11.5%) identified a different or mixed race. All participants were assigned male at birth with 818 (92.4%) identifying as cisgender male, 45 (5.1%) identifying as transgender female, and 22 (2.5%) identifying as other. With regard to participants' self-identified sexual

orientation, 599 (67.7%) identified as gay, 201 (22.7%) identified as bisexual, and 85 (9.6%) identified as other.

In terms of PrEP use at baseline, 76 (8.6%) participants had used PrEP in their lifetime with 58 (6.6%) participants reporting PrEP use in the six-month period preceding interview. Sample characteristics stratified by whether or not the participant had used PrEP in the past six months are shown in Table 1. There were 542 (61.2%) participants who reported at least one instance of condomless anal sex with a male partner in the past six months. The mean number of male sexual partners in the past six months was 2.6 (SD = 4.0). Based on CUDIT scores, 590 (66.7%) participants reported non-hazardous marijuana use or non-use, 132 (14.9%) reported hazardous use, and 161 (18.2%) reported having a possible marijuana use disorder. We also found that 248 (28.0%) participants reported using any other drug. Among these, the following ten substances were used: cocaine (107, 12.1%), heroin (3, 0.3%), GHB (7, 0.8%), methamphetamines (16, 1.8%), ketamine (14, 1.6%), nitrates (127, 14.4%), inhalants (11, 1.2%), psychedelics or hallucinogens (53, 6.0%), MDMA (86, 9.7%), and other drug(s) (7, 0.8%). Based on AUDIT score, we also found that 621 (70.2%), 213 (24.1%), and 51 (5.7%) participants reported low (or non-use), medium, and high levels of alcohol problems, respectively.

Demographic differences

Examining data at baseline, participants who used PrEP in the past six months were significantly older ($t = -3.27$, p -value = 0.001) than those who had not used PrEP. Past six-month PrEP users reported significantly more condomless sex ($\chi^2 = 13.98$, p -value < 0.001) and more sexual partners ($t = -5.10$, p -value = < 0.001) compared to those who had not used PrEP in the past 6 months. We did not observe significant differences between those who had and who had not used PrEP in the past six months with regard to race/ethnicity, education, gender identity, sexual orientation, employment status, alcohol problems, marijuana problems or drug use.

Regression analyses

Table 2 presents bivariate and multivariate model results examining past six-month PrEP use for participants at baseline. We found that, compared to those who had not engaged in condomless anal sex with male partner, those who engaged in condomless sex at least once in the past six months were significantly more likely to have taken PrEP in the past six months (Adjusted Odds Ratio [AOR] = 2.95; 95% Confidence Interval [CI]: 1.38–6.28). Those who reported more sex partners (AOR = 1.07; 95% CI: 1.03–1.12) as well as older individuals (AOR = 1.18; 95% CI: 1.07–1.30) were both significantly more likely to have used PrEP in the past six months. We also found that those who had more potentially hazardous marijuana use were significantly less likely to have used PrEP in the past six months (AOR = 0.94; 95% CI: 0.89–0.99). No significant differences were found with regards to race/ethnicity, education, other drug use, nor alcohol use.

We examined trends in past six-month PrEP use over the first three study visits among those participants who had completed all three visits (Figure 1). Overall, we observed an increase in past six-month PrEP use across all visits from 6.6% in visit one to 17.5% in visit three.

Across visits one, two and three, we observed increases in past six-month PrEP usage among black participants: 8.8%, 11.5%, and 15.3%; white participants: 9.4%, 17.4%, and 20.9%; Hispanic participants: 5.2%, 12.6%, and 14.9%; and other race participants: 9.3%, 17.0%, and 25.0%. In unadjusted Poisson analyses, we found significant increases only among white (Incidence Rate Ratio [IRR] = 1.45; 95% CI: 1.04–2.02) and Hispanic (IRR = 1.59; 95% CI: 1.11–2.28) participants; the increase in past six-month PrEP use among black and other race participants was not statistically significant (data not shown). Further, across visits, Hispanic participants experienced the greatest increase in PrEP uptake at each visit (58.8%), followed by white (44.7%), then black participants (31.5%).

Finally, we examined PrEP adherence among current PrEP users at visits one, two and three. For these analyses, we utilized all available data, as opposed to restricting the analytic sample to those participants who have completed all three waves. Out of 219 PrEP participants who reported PrEP use in the past six-months, 155 (70.8%) reported PrEP usage at *the time of interview*: 40 of 58 (69.0%) at visit one, 63 of 81 (77.8%) at visit two, and 52 of 80 (65%) at visit three. Across waves, 49 (31.6%) participants received the set of adherence questions that were added at later study visits. We observed that across visits one (27/35, 77.1%), two (40/49, 81.6%), and three (18/22, 81.8%), a majority of individuals reported being at least 90% adherent to their PrEP medication. Out of all individuals who reported PrEP usage and were asked the adherence questions, only 7 (14.2%) reported being less than 60% adherent (missing more than 4 out of 7 doses in a week). More specifically, 14 (28.6%) missed a single dose in the past week, 9 (18.4%) missed one dose in the past month, 7 (14.3%) missed a dose more than a month ago, and 19 (38.8%) reported never having missed a dose. Among those who missed a dose in the past week, 10 (71.4%) missed only one dose, two (14.3%) missed two doses and two (14.3%) missed >5 doses each.

DISCUSSION

In a diverse sample of young, HIV-negative MSM in Chicago, we found that 6.6% had used PrEP in the six months preceding baseline interview in 2015 with only 4.5% reporting PrEP use at the time of interview. We also found that past six-month PrEP use had increased for the sample as a whole across the first three visits. However, the increase in past six-month use was significant only for white and Hispanic/Latino participants. Encouragingly, we found that the majority of participants reported at least 90% adherent to PrEP medication as prescribed across all three study visits. Finally, past six-month PrEP use was found to be associated with older age at baseline and a greater number of male sexual partners.

While considerable past research has focused on PrEP awareness and knowledge, our study instead focused on understanding demographic characteristics and risk behaviors associated with past six-month PrEP usage. Similar to past research,²⁴ we found that those who participated in high risk sexual behaviors, such as condomless anal sex with male partners and having a higher number of male sexual partners, were also those most likely to have taken PrEP during the past six months. These findings suggest that those who participate in high risk sexual behaviors may also be those most likely to use PrEP. An alternative explanation is also possible in that those who have a strong desire to stop using condoms, perhaps to increase pleasure or partner intimacy, are seeking out alternative methods of HIV

prevention. In fact, this question has been explored in past work in the RADAR cohort finding that participants engaged in higher rates of risk compensation (i.e., increased condomless anal sex) when they were on PrEP compared to times when they were not on PrEP.²⁵ Future research should continue to assess demographic and risk characteristics associated with PrEP uptake, particularly in a longitudinal context, which would aid in understanding whether the trends observed in this study hold up over time and how sexual risk behaviors do or do not change after stopping PrEP use.

We also observed an increasing trend of PrEP usage over the first three visits for the study sample as a whole, suggesting that PrEP uptake may be gaining traction, particularly among YMSM and TGW. Similar to past research,⁶ we found that younger individuals had lower uptake than older individuals, suggesting that adolescent and young adult MSM and TGW may be experiencing more barriers to PrEP use than older MSM and TGW. A recent report by AIDSmap noted that the number of prescriptions for Truvada nearly doubled in the period from January 2012 through October 2015, even as the number of reporting pharmacies decreased nearly 20%.³ This same report, however, also found a large disparity in PrEP usage with nearly three-quarters of prescriptions filled by white individuals, followed by Hispanics, then blacks, who had actually experienced a 2% decline in usage during the same period. Similarly, while we found all race/ethnicities to have relatively similar rates of PrEP usage at baseline, white and Hispanic participants increased their uptake of PrEP use (i.e., past 6 month use) at a faster rate than black participants. Although beyond the scope of the current analysis, these emerging racial disparities in PrEP uptake may be attributable to geographic differences in access to HIV care in Chicago, differential rates of insurance, or, as has been demonstrated in recent work, a decreased likelihood of black MSM meeting eligibility criteria for PrEP.²⁶ More research is needed to understand what might be contributing to these emerging disparities, including structural factors (e.g., lack of access to LGBT-affirming healthcare) and individual-level factors (e.g., negative beliefs about PrEP).

Current PrEP users in our study reported a high level of adherence to their PrEP medication regimen. The current analyses found that the majority of participants who were current PrEP users were at least 90% adherent with the majority of individuals missing only a single dose more than a week prior to the interview. While an important finding, past analyses have reported mixed results regarding the correlation between self-reported measures of PrEP adherence and plasma concentrations.^{27–31} In two separate studies, one phase II PrEP clinical trial²⁷ and one clinical study,²⁸ investigators reported strong correlations between self-reported PrEP adherence and hair and dried blood spot concentrations, respectively. Meanwhile, several other studies utilizing data from the iPrex,³⁰ VOICE,³¹ and FEM-PrEP trials²⁹ have reported poor correlations between self-report adherence measures and plasma concentrations with participants tending to over-report their level of adherence. However, if the observed levels of adherence in this analysis are indeed valid, they would suggest that not only are most individuals highly adherent but that those who have imperfect adherence are still likely achieving high levels of protection against HIV infection as suggested in past work.³² Plasma concentrations, although not measured in this study, remain as the gold standard measure and should continue to be utilized until more reliable participant-based measures are developed.

While we found several important factors associated with past six-month PrEP use, as well as an increasing rate of past six-month PrEP use, our findings should be considered in the context of their limitations. For the purposes of examining current trends in PrEP use, we utilized only those participants who had completed the first three waves of data collection; the trends observed in this analysis may therefore be subject to change as more data become available. Additionally, factors associated with PrEP use were only assessed utilizing the baseline data. As such, we cannot draw causal inferences based on these analyses, and a more comprehensive analysis following further data collection is warranted. Finally, this sample was a community sample rather than a probability sample and, as such, findings may not generalize to the larger population of HIV-negative YMSM and TGW.

Even in the context of our limitations, we have shown that there is an upwards trend of PrEP usage among YMSM and TGW, a population at particularly high risk of HIV acquisition, though we also have observed evidence that racial disparities in PrEP use may be emerging over time. We also demonstrated that those who engage in high-risk behaviors are also those most likely to report a history of past six-month PrEP usage. Future research should continue to assess longitudinal trends in PrEP uptake, adherence to medication, and ways of engaging the community in order to reduce PrEP-related stigma. Furthermore, as PrEP uptake continues to rise, more research will be needed to understand predictors of PrEP discontinuation, as well as patterns of sexual behavior change following discontinuation, in order to optimize its efficacy.

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Figure 1. Percent of participants in the analytic sample who reported PrEP use in the past six months, by visit and race/ethnicity, RADAR, Chicago 2015–2017 (N = 219).

Demographic characteristics of analytic sample at baseline, stratified by PrEP use in that past six months, RADAR, Chicago 2015–2017 (N = 885)

Table 1

Characteristic	Total (N = 885)		Have used PrEP [†] (n = 58)		No PrEP Use [†] (n = 827)		χ^2 p-value
	n	%	n	%	n	%	
Age, mean (SD)	20.8 (2.8)	–	21.9 (3.1)	–	20.7 (2.7)	–	0.001
Race & Ethnicity							0.386
Black	259	29.3	19	32.8	240	29.0	
White	251	28.4	19	32.8	232	28.1	
Hispanic	273	30.8	12	20.7	261	31.6	
Other	102	11.5	8	13.8	94	11.4	
Education							0.784
< High School	164	18.5	12	20.7	152	18.4	
High School/GED	206	23.3	13	22.4	193	23.3	
Some College/Assoc.	440	49.7	26	44.8	414	50.1	
Bachelor Degree	59	6.7	6	10.3	53	6.4	
> Bachelor Degree	16	1.8	1	1.7	15	1.8	
Gender Identity							0.388
Cis-male	818	92.4	51	87.9	767	92.7	
Trans-male	45	5.1	5	8.6	40	4.8	
Other	22	2.5	2	3.4	20	2.4	
Sexual Orientation							0.133
Gay	599	67.7	45	77.6	554	67.0	
Bisexual	201	22.7	7	12.1	194	23.5	
Other	85	9.6	6	10.3	79	9.6	
Employment							0.251
Unemployed	345	39.0	17	29.3	328	39.7	
Part-time	337	38.1	24	41.4	313	37.8	
Full-time	203	22.9	17	29.3	186	22.5	
Condomless Sex[†]	542	61.2	49	84.5	493	59.6	<0.001

Characteristic	Have used PrEP ¹			No PrEP Use ¹			χ^2 p-value
	Total (N = 885)	n	%	(n = 58)	n	%	
Number of male sexual partners,¹ mean (SD)	2.6 (4.0)	–	–	5.2 (6.2)	–	2.5 (3.8)	< 0.001
Drug Use¹							
Marijuana, ² mean (SD)	5.9	6.3	6.2	6.4	6.5	6.5	0.154
Any other drug use	248	28.0	22	37.9	226	27.3	0.082
Alcohol Dependency,^{1,3} mean (SD)	5.9	5.3	5.9	5.4	6.1	6.6	0.315
PrEP Usage							
PrEP adherence, ⁴ mean (SD)	87.9 (21.3)	–	–	87.9 (21.3)	–	–	–

Abbreviations: PrEP = pre-exposure prophylaxis; SD = standard deviation; WHO = World Health Organization

¹In the past six months

²Assessed using the CUDIT test and scoring method²⁰

³Based on the Alcohol Use Disorders Identification Test (AUDIT) and scored per WHO guidelines

⁴Percent of time participant reported taking PrEP as prescribed among those reporting current PrEP usage

Table 2

Models of selected characteristics with past six-month PrEP use at baseline, RADAR, Chicago 2015–2017 (N = 881)¹

	Bivariate Models		Multivariate Models	
	OR	95% CI	AOR	95% CI
Condomless Sex²				
Never	Ref	-	Ref	-
One time	3.67**	1.78–7.56	2.95**	1.38–6.28
Number of Sex Partners²	1.09**	1.04–1.14	1.07**	1.03–1.12
Age	1.15**	1.06–1.26	1.18**	1.07–1.30
Race/Ethnicity				
Black	Ref	-	Ref	-
White	1.03	0.53–2.00	0.99	0.45–2.19
Hispanic	0.58	0.28–1.22	0.54	0.24–1.21
Other	1.08	0.46–2.54	1.02	0.41–2.55
Education				
< High school	Ref	-	Ref	-
High school	0.85	0.38–1.92	0.65	0.27–1.56
Some college/Assoc.	0.80	0.39–1.62	0.51	0.23–1.14
Bachelors degree	1.30	0.49–3.46	0.40	0.12–1.34
Marijuana Use^{2,3}	0.97	0.92–1.01	0.94*	0.89–0.99
Other Drug Use^{2,4}				
Never	Ref	-	Ref	-
At least one drug	1.62	0.94–2.82	1.61	0.83–3.14
Alcohol Use^{2,5}	1.02	0.98–1.07	1.00	0.95–1.05

Abbreviations: PrEP = pre-exposure prophylaxis; OR = odds ratio; CI = confidence interval

* $p < 0.05$;

** $p < 0.001$

¹ Utilizing bivariate and multivariate logistic regression models

² In the past six months

³ Assessed using the CUDIT test and scoring method²⁰

⁴ Includes cocaine, heroin, methamphetamines, GHB, ketamine, poppers, inhalants, psychedelics, and ecstasy.

⁵ Based on the Alcohol Use Disorders Identification Test (AUDIT) and scored per WHO guidelines