


BMJ Open Health profiles and racial disparities among individuals on probation in Hennepin County, Minnesota, 2016: a cross-sectional study

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ABSTRACT

Objectives To estimate the health characteristics and racial/ethnic health disparities among a probation cohort in Hennepin County. We hypothesised the probation population would have higher health needs compared with the general population as well as significant racial/ethnic health disparities.

Design Cross-sectional study using linked administrative records.

Participants Of 7992 eligible individuals, 5873 met inclusion criteria of 6 or more months of eligibility for a full-benefit Minnesota healthcare plan.

Setting Probation system in Hennepin County in 2016.

Outcomes We compared health condition prevalence among our probation cohort with survey data from the general population and analysed by race/ethnicity. We also measured sociodemographic characteristics, including the use of safety-net services.

Results Individuals were predominantly male (80.5%), young (mean age: 35.5 years), and disproportionately black or African American (52.9%). A majority of individuals enrolled in Medicaid were eligible via Medicaid expansion (65.9%). Compared with the general population, individuals on probation had higher rates of substance use disorders (66.5% vs 8.1%), mental illness (55.3% vs 14.4%) and many physical conditions (eg, asthma: 17.0% vs 12.5%, chronic kidney disease: 5.8% vs 0.2%). White individuals on probation were significantly more likely than black or African American individuals to have a diagnosed substance use disorder (71.6% vs 62.0%) or mental health disorder (64.9% vs 48.5%), but fewer chronic physical health conditions (average: 0.52 vs 0.73 chronic physical conditions).

Conclusions Individuals on probation have high health needs, which vary substantially by race/ethnicity. Without attention to this variation, interventions to address health conditions in this population could worsen racial/ethnic disparities.

INTRODUCTION

More than 3.5 million individuals are on probation in the USA, accounting for nearly 1 in 70 US citizens and totalling more than jail and prison populations combined.^{1–3} Probation is an alternative to incarceration,

Strengths and limitations of this study

- This study describes the probation population using linked county administrative and healthcare claims data sets.
- Health conditions were determined by diagnosis codes from healthcare claims, and probation status was determined by county data, eliminating recall and social desirability bias.
- Analysing linked data sets provides county-specific, granular information that can inform local policies.
- Results were restricted to individuals in Hennepin County, Minnesota, and may not be generalisable.

meaning continued criminal justice reform measures may shift more individuals to serve sentences outside of prisons and jails.⁴ People on probation are disproportionately from racial and ethnic minority groups and have higher rates of many health conditions, including physical health, mental health and substance use conditions, compared with the general population.^{5 6} Nearly one-quarter of people recently on probation report having a disability.⁷ Age-adjusted studies have also shown that individuals on probation have a higher mortality rate than the general public.⁸ In addition to their complex health needs, individuals on probation also experience increased barriers to accessing outpatient medical care and disproportionately use emergency department and inpatient care, regardless of insurance status.⁶ Justice-involved populations also have considerable social barriers, with high rates of housing insecurity, poverty and unemployment.⁹

To date, estimates of the health and healthcare use patterns of probation populations have largely relied on national survey data and include both people currently on probation as well as people who were recently on probation.^{6 7} These studies are scarce in number



and limited by self-reporting bias, social desirability bias, and an inability to verify both disease diagnoses and probation status. Additionally, these approaches require primary data collection and do not capture local patterns in disease prevalence or corrections practices. Local and regional data are needed to inform tailored health interventions that improve access and health outcomes for individuals on probation.

Relative to periods of incarceration, there are unique challenges and opportunities to improve care and reduce health inequities during probation. While healthcare is constitutionally required for individuals who are incarcerated, no such obligation exists for individuals on probation.¹⁰ Yet, because individuals on probation are not incarcerated, they are able to access services in the community that do not exist in jails and prisons. For example, the Medicaid inmate exclusion policy prohibits incarcerated individuals from receiving care through Medicaid.¹¹ Because people on probation serve sentences in the community, they are able to maintain Medicaid eligibility and enrolment. Thus, individuals on probation represent a large group with poorly defined health profiles that could benefit from well-designed health interventions implemented within the civilian healthcare system.

To address gaps in the extant literature and inform interventions and practice at the county level, we estimated the health characteristics and racial/ethnic health disparities among a probation cohort in Hennepin County, using linked administrative records, 1. Our primary aim was to describe the sociodemographic and health characteristics of individuals on probation. Our secondary aim was to compare health characteristics with a national sample using survey data. We hypothesised that individuals on probation would have complex sociodemographic profiles, high health needs compared with general population estimates, and substantial differences in health conditions by race and ethnicity.

METHODS

Participants and data sources

We used healthcare claims and administrative probation data to describe health characteristics and disparities among individuals assigned to high-level probation at any point in 2016 with the Hennepin County Department of Community Corrections and Rehabilitation (DOCCR). High-level probation supervision is designed for individuals assessed as being at higher risk of re-offence and assigns one probation officer to oversee 40 individuals on probation. Clients typically meet with their probation officer once a month to discuss compliance with their probation conditions and other needs or problems they might have. We chose to examine individuals on high-level supervision because they frequently interact with probation officers. Thus, there are more opportunities for modifications to programming and outreach than for individuals on low-level or mid-level supervision. We

excluded people on warrant status because warrants are typically issued when someone cannot be located, and thus cannot actively be involved in probation. Individuals were included in our final cohort if they had 6 or more months of enrolment for a full-benefit Minnesota public health insurance programme (Minnesota Health Care Plan (MHCP)) between 1 January 2013 and 31 December 2016 and were adults aged 18 years or older on probation in 2016.

Health and health insurance enrolment data were drawn from claims from any MHCP, but primarily consisted of programmes available through the Affordable Care Act: Medicaid expansion, for individuals with incomes $\leq 138\%$ of the federal poverty level (FPL), and MinnesotaCare, the basic health plan for individual 138% FPL and $<200\%$ FPL. Criminal justice data came from multiple sources, including DOCCR probation records, court administrative data and statewide incarceration data. Housing and social service data came from Hennepin County administrative records. Health and criminal justice data were linked using *Link Plus* to probabilistically match on name and date of birth. Social service and housing data were linked to health data using a county-assigned, person-specific ID.

Patient and public involvement

Patients or the public were not involved in designing, conducting, reporting or plans for disseminating our research.

Outcomes

We used International Classification of Diseases (ICD) codes to assess physical health, mental health and substance use diagnoses. ICD ninth revision codes (ICD-9) were used for conditions documented between 1 January 2013 and 30 September 2015 and ICD tenth revision codes (ICD-10) were used for diagnoses documented between 1 October 2015 and 31 December 2016. Chronic Condition Data Warehouse Chronic Condition Categories were used to group diagnosis codes to describe physical and mental health conditions.¹² Physical health conditions included hypertension, ischemic heart disease, cancer, asthma, arthritis, diabetes, chronic kidney disease, chronic obstructive pulmonary disease and viral hepatitis. We also assessed pregnancy among women of childbearing age (ages 18–44 years) within the last 12 months of ending probation. Mental health diagnoses included depression, anxiety, bipolar disorder, post-traumatic stress disorder, and schizophrenia and other psychotic disorders. The latter category, schizophrenia and other psychotic disorders, we defined as a comparator to National Survey on Drug Use and Health's (NSDUH) estimates of serious mental illness. Substance use disorder (SUD) groupings were derived from Healthcare Cost and Utilization Project definitions.^{13 14} Conditions included alcohol, cannabis, opioid, methamphetamine, cocaine/crack, sedatives or unspecified/other SUDs.

Sociodemographic characteristics

We examined a range of sociodemographic factors including age, gender, race/ethnicity, health insurance enrolment, employment status, education level, number of children and marital status. Health insurance type was determined by any full or partial month of enrolment at any point while on probation in 2016. Sociodemographic variables, with the exception of health insurance enrolment, were determined based on DOCCR administrative data.

To better understand the non-health care needs of individuals on probation, we also examined use of other safety-net services. We estimated the number of individuals who used a variety of social programmes, including the supplemental nutrition assistance programme, general assistance, temporary assistance for needy families or cash assistance. We also assessed the proportion of individuals who used emergency shelter or supportive housing services.

Statistical analysis

We first described sociodemographic characteristics among all individuals on high-level probation and then stratified characteristics by race/ethnicity.

Next, we described the proportion of individuals on probation who used social services and housing supports. We examined use of these services at any point while an individual who met our health insurance enrolment criteria was on probation in 2016.

We then analysed the unadjusted prevalence of health conditions among our probation cohort using ICD-9 and ICD-10 codes.

For our general population comparisons, we used the Behavioral Risk Factor Surveillance System (BRFSS) to ascertain the general population prevalence of several physical health conditions in Minnesota. BRFSS is conducted by the US Centers for Disease Control and Prevention and is a telephone-based survey.¹⁵ We used the 2015–2016 NSDUH for national rates of SUD and mental health conditions in the general population.^{16 17} NSDUH does not provide state-level variables in its public use data file. NSDUH is conducted by the US Substance Abuse and Mental Health Services Administration and is a household survey conducted by a trained interviewer. Both BRFSS and NSDUH are widely used, population-based surveys that are intended to provide national and state-level estimates of physical health, mental health and substance use conditions. Though NSDUH does not contain granular information about mental health conditions, the survey does estimate levels of current depression in the USA, as well as any mental illness and any serious mental illness.

To provide comparisons with disease prevalence data in the general population, we compared rates of physical health conditions among individuals in our probation cohort with the general population in Minnesota using data from BRFSS. Similarly, we compared rates of certain substance use and mental health diagnoses to similar conditions among a national population in NSDUH.

Comparisons between our probation cohort and survey populations were estimated using linear probability models and were adjusted for age and gender to eliminate confounding health risk factors. For comparisons with national data, each observation in the high-supervision probation data was assigned single-unit weight. Weights for observations from national and state survey data were rescaled to match the size of the high-level supervision probation cohort before performing comparisons. We generated predicted probabilities adjusted for age and gender using Stata's *margins* command and set covariates at mean values of our probation cohort.

Finally, we evaluated rates of health conditions among individuals on probation by race and ethnicity and assessed the significance of these differences after adjusting for age and gender.

All analyses used Stata V.15.1 (College Station, Texas, USA). We considered $p < 0.05$ to be statistically significant.

RESULTS

Sociodemographic characteristics of individuals on high-level probation

Of the 7992 adults on high-level probation in Hennepin County in 2016, our sample consisted of 5873 adults who met enrolment criteria (table 1). Individuals on high-level probation in Hennepin County were predominantly young (mean age 35.5 years), male (80.5%) and black or African American (52.9%). They were unemployed at higher rates than the general public (38.2% among individuals on probation vs 3.9% in Minnesota (not reported in table)).¹⁸ Among those with available data, the majority had one or more children (72.4%). Most individuals were enrolled in Medicaid (table 1) while on probation in 2016 (80.7%). Of the individuals enrolled in Medicaid, a majority (65.9%) were eligible via Medicaid expansion under the Affordable Care Act. Sociodemographic profiles varied considerably by race and ethnicity (online supplemental file 1).

Social service and housing services among individuals on probation

Over half of individuals on probation received food support (table 1), and 39.2% received some form of income support while on probation. General assistance was the most common at 27.1%. Approximately 6.8% used shelter or supportive housing services while on probation in 2016.

Health characteristics of individuals on high-level probation

In unadjusted analyses, 35.0% of individuals on probation in Hennepin County had one or more chronic physical health condition despite a mean age of 35.5 years (table 2). Hypertension (17.3%) and asthma (14.3%) were the most common physical health conditions. A majority of individuals had either a diagnosed SUD (66.4%) or mental health diagnosis (55.0%). Among the diagnosed SUDs, alcohol use disorder was the most

Table 1 Demographics, public health insurance prevalence and social service use of individuals on high-level probation in Hennepin County, Minnesota, anytime during 2016

	Hennepin County probation cohort	
	n	%
Cohort		
High-level probation meeting enrolment criteria	5873	–
Median age	33.0	
Mean age	35.5	
Male	4726	80.5
Race/ethnicity		
White, non-Hispanic	2055	35.0
Black or African American	3104	52.9
Native American	324	5.5
Asian or Pacific Islander	114	1.9
Hispanic	212	3.6
Other	64	1.1
Health insurance enrolment (while on high-level probation in 2016)		
Any Minnesota Health Care Plan (MHCP)	5116	87.1
Consolidated treatment fund	1346	22.9
Any full-benefit MHCP	4931	84.0
Medicaid	4742	80.7
MinnesotaCare	5116	4.6
Medicaid eligibility types (among those enrolled in Medicaid in 2016)		
Expansion	3126	65.9
Disability, no Medicare/social service	472	10.0
Disability, with Medicare/social service	327	6.9
Parent	808	17.0
Other	328	6.9
Employment		
Part-time	1039	17.7
Full-time	1347	22.9
Unemployed	2242	38.2
Other	131	2.2
Unknown	1114	19.0
Education		
High school, not completed	1258	21.4
High school, completed	1360	23.2
Graduate Equivalency Degree	725	12.3
Some college or higher education	1442	24.6
Unknown	1088	18.5
Children		
0	1622	27.6
1	998	17.0

Continued

Table 1 Continued

	Hennepin County probation cohort	
	n	%
2	812	13.8
3+	1272	21.7
Unknown	1169	19.9
Marital status		
Married	408	6.9
Single	4399	74.9
Unknown	1066	18.2
Social service use		
Food support (SNAP)	3189	54.3
Cash support	2305	39.2
General assistance	1593	27.1
Temporary assistance for needy families	491	8.4
Other income support	328	5.6
Group residential housing	873	14.9
Shelter	398	6.8

Counts for people on high-level probation anytime during 2016 and with 6+ months of full-benefit public health insurance eligibility between 2013 and 2016 in Minnesota. MHCP includes any full or partial month while on high-level probation in 2016. Counts are not exclusive and do not add up to 100%. SNAP, supplemental nutrition assistance programme.

common (41.2%), followed by cannabis (29.0%) and opioids (18.3%). Among diagnosed mental health conditions, anxiety and depression were the most common (42.9% and 41.9%, respectively). Close to half of the individuals on probation had both a diagnosed SUD and mental health condition (44.9%).

Health characteristics of individuals on high-level probation compared with general population estimates

In adjusted analyses, individuals on probation in Hennepin County were significantly more likely ($p < 0.001$) to have nearly all physical health conditions measured in this study as compared with the general population in Minnesota, with the exception of arthritis (table 3).

Individuals on probation in Hennepin County were significantly more likely ($p < 0.001$) to have any of the reported diagnosed SUDs (66.5% vs 8.1%), as well as any mental health condition (55.3% vs 14.4%) compared with a national sample from NSDUH (table 3). Specifically, individuals on probation in Hennepin County were more likely to have a diagnosis of severe mental illness (12.5% vs 4.3%) and depression (41.6% vs 9.4%) as compared with the general population. Individuals on probation in Hennepin County were nearly 20 times more likely to have both a diagnosed SUD and mental health condition compared with the general population (44.7% vs 2.6%).

Table 2 Health conditions of individuals on high-level probation in Hennepin County, Minnesota, anytime during 2016

	Hennepin County probation cohort	
	n	%
Cohort	5873	
Women of childbearing age (18–44 years)	932	11.7
Physical conditions		
Hypertension	1015	17.3
Asthma	842	14.3
Arthritis	513	8.7
Diabetes	346	5.9
Cancer	29	0.5
Heart disease	157	2.7
Chronic kidney disease	337	5.7
COPD	211	3.6
Viral hepatitis	276	4.7
Number of chronic physical conditions*		
0	3815	65.0
1	1146	19.5
2+	912	15.5
Pregnant in last 12 months (% of women aged 18–44)	99	10.6
Substance use disorders (SUDs)		
Any SUD	3901	66.4
Alcohol	2417	41.2
Cannabis	1703	29.0
Opioid	1074	18.3
Methamphetamine	936	15.9
Cocaine/crack	852	14.5
Sedatives	182	3.1
Unspecified/other SUD	1732	29.5
Two or more SUDs	1957	33.3
Mental health		
Any mental health	3233	55.0
Depression	2461	41.9
Anxiety	2517	42.9
Bipolar	1195	20.3
PTSD	1000	17.0
Severe MI	748	12.7
SUD+MI		
Any SUD and any MI	2635	44.9

Counts for people on high-level probation anytime during 2016 and with 6+ months of full-benefit public health insurance eligibility between 2013 and 2016 in Minnesota.

Includes people with violation status, but not warrant status. Conditions from ICD-9 diagnosis codes 2013–Q3 2015, ICD-10 codes Q4 2015–2016. Physical and mental health conditions grouped according to Centers for Medicare and Medicaid Services Chronic Condition Warehouse specifications. SUD conditions grouped according to Healthcare Cost and Utilization Project specifications, excluding remission codes.

*Chronic physical conditions include hypertension, chronic kidney disease, ischemic heart disease, diabetes, cancer, stroke, asthma, arthritis and COPD. COPD, chronic obstructive pulmonary disease; ICD-9, International Classification of Diseases ninth revision; ICD-10, International Classification of Diseases 10th revision; MI, mental illness; PTSD, post-traumatic stress disorder.

Health characteristics of individuals on probation by race/ethnicity

Among individuals on probation in Hennepin County, black or African American individuals had significantly higher rates of physical health diagnoses when compared with white, non-Hispanic individuals (table 4). Black or African American individuals were less likely to have a diagnosed SUD or mental health conditions when compared with white, non-Hispanic individuals, (62.0% vs 71.6%, $p<0.001$; 48.5% vs 64.9%, $p<0.001$), but had significantly higher rates of several select conditions, including cannabis use (30.7%), cocaine use (17.6%) and severe mental illness (13.6%). White, non-Hispanic individuals had the highest rates of diagnosed methamphetamine use disorders (29.1%) compared with other race/ethnicity subcategories. Native American individuals had the highest rates of diagnosed opioid use disorder compared with other race or ethnic groups, with rates nearly double that of white, non-Hispanics. However, white, non-Hispanic individuals had diagnosed opioid use disorder at over twice the rate of black or African American and Asian or Pacific Island individuals. Overall, white, non-Hispanic and Native American individuals had the highest rates of many mental health condition diagnoses.

DISCUSSION

In this analysis of linked cross-sector administrative data, we found that individuals on probation had complex sociodemographic profiles as well as high rates of chronic physical, mental health and substance use conditions. Individuals on probation had poorer health compared with the general population in nearly every assessed category. Substance use and mental health conditions were particularly prevalent, with 44.9% of individuals on probation having simultaneous diagnoses for substance use and mental health conditions. These findings add to a growing body of literature that indicates individuals on probation have substantial physical and behavioural health needs, which necessitate access to quality healthcare while on supervision. Additionally, the frequent use of safety-net services highlights the considerable social barriers faced by people on probation. We show that local administrative data can be used to glean important insights about the health of this key population, without requiring primary data collection, and provide more detailed information related to mental health and substance use diagnoses. For example, we quantified the prevalence of specific SUDs and mental health diagnoses to show that use of multiple different substances is common within this population, as are numerous coexisting mental health diagnoses, suggesting that interventions focused on one particular substance or mental health condition may not be effective.

Consistent with previous studies of health in justice-involved populations, we found significant health differences between racial and ethnic groups in our probation

**Table 3** Health condition prevalence of individuals on high-level probation in Hennepin County, Minnesota, anytime during 2016, versus general population

	Hennepin County probation cohort, adjusted for age and sex (95% CI)	BRFSS comparison, adjusted for age and sex (95% CI)	NSDUH comparison, adjusted for age and sex (95% CI)
n=5873			
Physical conditions			
Hypertension	17.0% (16.0% to 18.0%)	12.5% (11.4% to 13.6%)	
Asthma	14.5% (13.6% to 15.4%)	5.5% (4.9% to 6.1%)	
Arthritis	7.8% (7.0% to 8.5%)*	8.2% (7.6% to 8.8%)*	
Diabetes	5.7% (5.1% to 6.4%)	3.2% (2.8% to 3.7%)	
Chronic kidney disease	5.8% (5.1% to 6.4%)	0.2% (-0.1% to 0.5%)	
COPD	3.4% (2.9% to 4.0%)	1.2% (0.8% to 1.5%)	
Substance use disorders (SUDs)			
Any SUD	66.5% (65.3% to 67.7%)		8.1% (7.6% to 8.5%)
Alcohol	40.9% (39.7% to 42.2%)		6.3% (5.9% to 6.7%)
Cannabis	28.3% (27.1% to 29.5%)		1.7% (1.5% to 1.8%)
Opioid	17.6% ((16.6% to 18.6%)		0.7% (0.6% to 0.8%)
Methamphetamine	14.9% (14.0% to 15.9%)		0.2% (0.2% to 0.3%)
Cocaine/crack	13.2% (12.3% to 14.1%)		0.2% (0.2% to 0.3%)
Sedatives	2.9% (2.5% to 3.4%)		0.1% (0.0% to 0.1%)
Mental health			
Any mental health condition	55.3% (54.0% to 56.6%)		14.4% (13.4% to 15.1%)
Depression	41.6% (40.4% to 42.9%)		9.4% (8.9% to 10%)
Severe MI	12.5% (11.7% to 13.4%)		4.3% (3.9% to 4.6%)
SUD+MI			
Any SUD and any MI	44.7% (43.4% to 46.0%)		2.6% (2.3% to 2.8%)

Counts for people on high-level probation anytime during 2016 and with 6+ months of full-benefit public health insurance eligibility between 2013 and 2016 in Minnesota.

Includes people with violation status, but not warrant status.

Conditions from ICD-9 diagnosis codes 2013–Q3 2015, ICD-10 codes Q4 2015–2016. Physical and mental health conditions grouped according to Centers for Medicare and Medicaid Services Chronic Condition Warehouse specifications. SUD conditions grouped according to Healthcare Cost and Utilization Project specifications, excluding remission codes.

Adjusted to age and gender distributions for the high-level cohort. Physical condition comparisons use BRFSS 2015–2016 values for Minnesota, SUD and MI conditions use NSDUH values for the USA.

*Values which were not significantly different. All other values were significant ($p < 0.0001$) based on bivariate statistical testing.

BRFSS, Behavioral Risk Factor Surveillance System; COPD, chronic obstructive pulmonary disease; ICD-9, International Classification of Diseases ninth revision; ICD-10, International Classification of Diseases 10th revision; MI, mental illness; NSDUH, National Survey on Drug Use and Health.

cohort.^{19 20} Unlike previous national studies which found similar rates of chronic disease among white, black and Native American individuals, we found higher levels of physical health conditions among black and Native American individuals compared with white, non-Hispanic individuals.⁴ However, our findings are consistent with other work using NSDUH that found self-reported mental illness was higher among white, non-Hispanic individuals compared with other racial and ethnic groups.^{21–23} We build on this work using diagnosed conditions to show that severe mental illness (eg, schizophrenia and other psychotic disorders) was more often diagnosed among black individuals, while lower severity mental illness (eg, anxiety and depression) was less diagnosed compared

with white, non-Hispanics. It is important to consider how structural racism may contribute to these differences in physical and mental health conditions and SUDs between racial and ethnic groups. A growing body of evidence points to public policies and institutional practices that perpetuate disparities in who becomes involved in the criminal legal system and how individuals are diagnosed with and treated for their health conditions.^{24 25} Future research should consider how policies and practices in the criminal legal and healthcare systems can promote health and reduce inequities among people on probation.

Our findings can inform interventions specific to the unique barriers and opportunities that exist during a period of probation. For example, given the rates of

Table 4 Health conditions of individuals on high-level probation in Hennepin County, Minnesota, anytime during 2016, by race and ethnicity

	Hennepin County probation cohort (95% CI)				
	White, non-Hispanic (N=2055)	Black or African American (N=3103)	Native American (N=324)	Asian or Pacific Islander (N=114)	Hispanic (N=212)
Physical conditions					
Asthma	10.8% (9.5% to 12.2%)	17.4%*** (16.1% to 18.8%)	12.9% (9.5% to 16.4%)	11.0% (5.2% to 16.9%)	12.9% (8.4% to 17.5%)
Diabetes	4.2% (3.4% to 5.0%)	6.8%*** (5.9% to 7.7%)	10.2%*** (7.0% to 13.4%)	3.9% (0.2% to 7.5%)	8.4% (4.3% to 12.5%)
Hypertension	13.7% (12.4% to 15.0%)	20.5%*** (19.1% to 21.8%)	20.1%** (16.2% to 24.1%)	9.8% (4.4% to 15.1%)	16.2% (11.1% to 21.3%)
Arthritis	7.2% (6.2% to 8.1%)	10.2%*** (9.1% to 11.2%)	12.4%*** (9.1% to 15.7%)	2.1%*** (-0.7% to 4.9%)	5.9% (2.2% to 9.6%)
CKD	5.2% (4.3% to 6.1%)	6.0% (5.1% to 6.8%)	7.7% (4.8% to 10.6%)	5.4% (1.2% to 9.5%)	5.5% (2.2% to 8.8%)
COPD	3.7% (2.9% to 4.4%)	3.7% (3.0% to 4.4%)	3.4% (1.4% to 5.3%)	2.8% (-0.3% to 5.9%)	2.5% (0.1% to 4.9%)
Viral hepatitis	6.1% (5.1% to 7.0%)	3.1%*** (2.5% to 3.8%)	10.1%* (6.9% to 13.3%)	0.9%*** (-0.8% to 2.6%)	5.7% (2.3% to 9.1%)
Ischemic heart disease	2.6%*** (1.9% to 3.2%)	2.8%*** (2.2% to 3.3%)	2.7%** (0.9% to 4.6%)	2.8% (-0.3% to 5.9%)	3.8%* (0.9% to 6.7%)
Cancer	0.3%** (0.1% to 0.5%)	0.7%*** (0.4% to 1.0%)	0.7% (-0.2% to 1.6%)	-	0.5% (-0.5% to 1.5%)
Average # of chronic physical conditions (0-9)*	0.52 (0.48 to 0.55)	0.73 (0.69 to 0.76)***	0.75 (0.63 to 0.87)†	0.42 (0.25 to 0.59)	0.56 (0.41 to 0.71)
Substance use disorders (SUDs)					
Any SUD	71.6% (69.7% to 73.6%)	62.0%*** (60.3% to 63.7%)	85.9%*** (82.0% to 89.7%)	47.7%*** (38.6% to 56.8%)	66.3% (60.1% to 72.5%)
Alcohol	43.3% (41.2% to 45.4%)	38.5%** (36.8% to 40.2%)	59.2%*** (53.9% to 64.4%)	24.8%*** (17.0% to 32.7%)	42.5% (35.9% to 49.1%)
Cannabis	27.3% (25.3% to 29.2%)	30.7%*** (29.1% to 32.3%)	35.8%** (30.6% to 40.9%)	8.8%*** (3.6% to 13.9%)	21.5%* (16.2% to 26.9%)
Cocaine	10.1% (8.9% to 11.3%)	17.6%*** (16.2% to 18.9%)	20.5%*** (16.3% to 24.7%)	5.6%* (1.3% to 9.9%)	16.4%* (11.2% to 21.5%)
Methamphetamine	29.1% (27.1% to 31.1%)	5.5%*** (4.7% to 6.3%)	27.9% (23.1% to 32.7%)	17.4%*** (10.6% to 24.3%)	15.0%*** (10.2% to 19.8%)
Opioids	24.8% (22.9% to 26.6%)	11.5%*** (10.3% to 12.6)	41.2%*** (35.9% to 46.5%)	7.2%*** (2.4% to 12.0%)	23.5% (17.7% to 29.2%)
Sedatives	5.8% (4.8% to 6.9%)	1.1%*** (0.7% to 1.4%)	3.9% (1.9% to 5.9%)	1.8%*** (-0.7% to 4.2%)	6.4% (3.1% to 9.6%)
Unspecified SUD	35.6% (33.6% to 37.7%)	24.8%*** (23.3% to 26.4%)	41.7%* (36.4% to 47.1%)	17.1%*** (10.2% to 24.0%)	23.4%*** (17.7% to 29.2%)
Mental health					
Any MI	64.9% (62.8% to 66.9%)	48.5%*** (46.8% to 50.3%)	67.5% (62.3% to 72.6%)	34.6%*** (26.1% to 43.1%)	52.8%** (46.3% to 59.3%)
Anxiety	53.0% (50.9% to 55.1%)	35.4%*** (33.7% to 37.0%)	55.1% (49.7% to 60.6%)	28.3%*** (20.1% to 36.4%)	44.0%* (37.5% to 50.6%)
Bipolar	23.5% (21.7% to 25.3%)	18.6%*** (17.2% to 20.0%)	19.4% (15.3% to 23.5%)	10.9%*** (5.2% to 16.7%)	20.2% (14.7% to 25.6%)
Depression	49.0% (46.9% to 51.1%)	36.8%*** (35.2% to 38.5%)	51.4% (46.0% to 56.7%)	24.0%*** (16.3% to 31.7%)	42.3% (35.9% to 48.7%)
PTSD	17.3% (15.7% to 18.8%)	16.6% (15.3% to 17.9%)	22.2%* (17.9% to 26.4%)	9.1%*** (3.8% to 14.4%)	17.6% (12.4% to 22.7%)
Severe MI	11.2% (9.9% to 12.6%)	13.6%* (12.4% to 14.9%)	16.6%* (12.6% to 20.7%)	9.8% (4.3% to 15.2%)	10.9% (6.5% to 15.2%)
SUD+MI					
Any SUD and any MI	53.2% (51.1% to 55.3%)	38.5%*** (36.8% to 40.1%)	63.9%*** (58.7% to 69.2%)	21.8%*** (14.3% to 29.4%)	42.9%** (36.3% to 49.4%)

Continued



Table 4 Continued

	Hennepin County probation cohort (95% CI)				
	White, non-Hispanic (N=2055)	Black or African American (N=3103)	Native American (N=324)	Asian or Pacific Islander (N=114)	Hispanic (N=212)
Other conditions					
Personality disorders	15.4% (13.9% to 16.9%)	10.0%*** (8.9% to 11.0%)	11.0%* (7.8% to 14.3%)	7.3%** (2.5% to 12.2%)	13.0% (8.3% to 17.7%)

Race and ethnicity designations from data maintained by Hennepin County Corrections.

Counts for people on high-level probation anytime during 2016 and with 6+ months of full-benefit public health insurance eligibility between 2013 and 2016 in Minnesota. Includes people with violation status, but not warrant status.

Conditions from ICD-9 diagnosis codes 2013–Q3 2015, ICD-10 codes Q4 2015–2016. Physical and mental health conditions grouped according to Centers for Medicare and Medicaid Services Chronic Condition Warehouse specifications. SUD conditions grouped according to Healthcare Cost and Utilization Project specifications, excluding remission codes.

* $p < 0.05$ in bivariate comparison with white, non-Hispanic; ** $p < 0.01$ in bivariate comparison with white, non-Hispanic; *** $p < 0.001$ in bivariate comparison with white, non-Hispanic.

CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; ICD-9, International Classification of Diseases ninth revision; ICD-10, International Classification of Diseases 10th revision; MI, mental illness; PTSD, post-traumatic stress disorder.

physical, mental and substance use conditions, individuals on probation should have the opportunity to connect with a trusted healthcare partner to assess, diagnose and treat underlying medical conditions. These assessments should be free of coercion and should not be predicated on the conditions of supervision. Probation offices should prioritise programmes that help clients enrol in and maintain health insurance, particularly in Medicaid expansion states and social services. Next, the high rates of safety-net service use in our cohort argue for collaboration between healthcare services and community services in order to address unmet needs relating to social determinants of health. Finally, the disaggregation of health conditions by race and ethnicity can inform interventions that recognise and address existing health inequities. For example, because of different rates of specific substance use between racial/ethnic groups, focusing an intervention on only the most prevalent substance use disorder has the potential to disproportionately benefit one racial/ethnic group and unintentionally exacerbate disparities. Our data suggest that an isolated focus on more prevalent substances, such as opioids or methamphetamine, could unintentionally contribute to and perpetuate racial inequities. Programmes that provide access to treatment for any type of substance use are likely to be more equitable than programmes focusing on a single common substance.

This study has several limitations. First, individuals were only included if they had 6 or more months of eligibility for a full-benefit MHCP in the previous 3 years. Omitting individuals who did not qualify for public healthcare plans could potentially drop individuals who have incomes too high to qualify for such plans. Second, although we controlled for age and gender, our comparison populations of BRFSS for physical conditions and NSDUH for mental health conditions and SUDs were self-reported conditions and we did not have access to diagnosis information for a general population cohort. Third, our study focused on an urban, Midwest county and it is possible that our findings do not generalise when assessed nationally, though they should be comparable with other urban jurisdictions. Finally, while we stratified our findings by race/ethnicity, we do not directly measure the contribution of racism to the disparities we identified.

Our study describes the unique health needs of people on probation and highlights the racial/ethnic differences that exist within this population. By linking local administrative data across public sectors, jurisdictions can identify opportunities to improve programmes and connect individuals to needed resources. This work also highlights the importance of disaggregating diagnoses by race and ethnicity to inform policy decisions. Often overlooked in discussions of correctional healthcare, people on probation represent a key population for whom targeted public health interventions could improve health and address existing inequities.

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Supplemental 1. Demographics and public health insurance prevalence of individuals on high-level probation in Hennepin County, Minnesota, any time during 2016 and met MHCP enrollment criteria by race and ethnicity.

Cohort	HC probation cohort									
	White, non-Hispanic		Black or African American		Native American		Asian or Pacific Islander		Hispanic	
	n	%	n	%	n	%	n	%	n	%
High-level probation meeting enrollment criteria	2055	35.0%	3104	52.9%	324	5.5%	114	1.9%	212	3.6%
Median age	35.4		31.5		32.7		32.3		29.2	
Average age	37.7		34.4		34.7		35.2		32.6	
Male	1580	76.9%	2629	84.7%	201	62.0%	97	85.1%	175	82.5%
Health Insurance Enrollment (While on high-level probation in 2016)										
Any Minnesota Health Care Plan (MHCP)	1821	88.6%	2670	86.0%	292	90.1%	95	83.3%	188	88.7%
Consolidated treatment fund	466	22.7%	666	21.5%	129	39.8%	24	21.1%	55	25.9%
Any full-benefit MHCP	1769	86.1%	2558	82.4%	282	87.0%	92	80.7%	181	85.4%
Medicaid	1676	81.6%	2487	80.1%	279	86.1%	87	76.3%	167	78.8%
MinnesotaCare	141	6.9%	97	3.1%	--	--	--	--	18	8.5%
Medicaid Eligibility Types (among those enrolled in Medicaid in 2016)										
Expansion	1218	72.7%	1524	61.3%	191	68.5%	54	62.1%	116	69.5%
Disability, no Medicare/SS	107	6.4%	323	13.0%	23	8.2%	--	--	--	--
Disability, with Medicare/SS	129	7.7%	177	7.1%	--	--	--	--	--	--
Parent	247	14.7%	441	17.7%	50	17.9%	28	32.2%	29	17.4%
Other	70	4.2%	204	8.2%	17	6.1%	--	--	--	--
Employment										
Part-time	363	17.7%	574	18.5%	28	8.6%	22	19.3%	39	18.4%
Full-time	539	26.2%	675	21.7%	31	9.6%	27	23.7%	55	25.9%
Unemployed	685	33.3%	1251	40.3%	184	56.8%	35	30.7%	70	33.0%
Other	49	2.4%	68	2.2%	--	--	--	--	--	--
Unknown	419	20.4%	536	17.3%	--	--	--	--	--	--
Education										
High school, not completed	259	12.6%	792	25.5%	112	34.6%	--	--	57	26.9%
High school, completed	439	21.4%	759	24.5%	66	20.4%	29	25.4%	49	23.1%
GED	247	12.0%	403	13.0%	48	14.8%	--	--	17	8.0%
Some college or higher education	631	30.7%	688	22.2%	36	11.1%	12	10.5%	33	15.6%
Unknown	479	23.3%	462	14.9%	52	16.0%	28	24.6%	45	21.2%
Children										
0 Children	703	34.2%	729	23.5%	75	23.1%	38	33.3%	66	31.1%
1 Child	330	16.1%	564	18.2%	61	18.8%	--	--	25	11.8%
2 Children	238	11.6%	470	15.1%	52	16.0%	--	--	31	14.6%
3+ Children	264	12.8%	859	27.7%	84	25.9%	--	--	36	17.0%
Unknown	520	25.3%	482	15.5%	52	16.0%	32	28.1%	46	21.7%
Marital Status										
Married	157	7.6%	197	6.3%	14	4.3%	--	--	17	8.0%
Single	1473	71.7%	2415	77.8%	252	77.8%	--	--	156	73.6%
Unknown	425	20.7%	492	15.9%	58	17.9%	30	26.3%	39	18.4%

Counts for people on high-level probation any time during 2016 and with 6+ months full-benefit public health insurance eligibility between 2013 and 2016 in Minnesota

Includes people with violation status, but not warrant status.

Minnesota Health Care Plans (MHCP) includes any full or partial month while on high-level probation in 2016. Counts are not exclusive and do not add up to 100 percent.