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Traumatic Brain Injury among Native Hawaiian and Pacific Islander Veterans accessing Veterans Health Administration Homeless Services: A Preliminary Examination

Ryan Holliday, PhD[1,2,3,4], Sara Lum, PhD[4], Christine Kindler, PhD[4], Shiloh E Jordan, PhD[4], Darrin Aase, PhD[4], Gayle Y Iwamasa, PhD[5], Shawn Liu, MSW[6], Jack Tsai, PhD[3,7,8], Lauren E Molella, PsyD[9], Lindsey L Monteith, PhD[1,2,4]

[1] VA Rocky Mountain Mental Illness Research, Education and Clinical Center for Suicide Prevention, [2] University of Colorado Anschutz Medical Campus, [3] VA National Center on Homelessness Among Veterans, [4] VA Pacific Islands Health Care System, [5] VA Office of Mental Health and Suicide Prevention, [6] VA Homeless Programs Office, [7] University of Texas Health Science Center at Houston, School of Public Health, [8] Yale University School of Medicine, [9] VA Eastern Colorado Health Care System

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Abstract

Veterans experiencing homelessness have elevated rates of traumatic brain injury (TBI) diagnoses. There remains limited research on subsets of homeless Veterans, including Native Hawaiian and Pacific Islander (NHPI) Veterans. Department of Veterans Affairs (VA) electronic medical records of 724 752 Veterans who accessed Veterans Health Administration (VHA) homeless services from January 2005–December 2018 were examined. Of the total sample, 1177 identified as NHPI, with comparator samples of non-NHPI (n=723 575) and White (n=418 085) Veterans also generated. Rates of TBI were compared between NHPI Veterans relative to non-NHPI Veterans, as well as between NHPI and White Veterans (a subset of the non-NHPI Veteran sample). NHPI homeless Veterans were more likely to have a documented TBI diagnosis relative to non-NHPI homeless Veterans (AOR=1.82, 95% CI: 1.57-2.11), including the White homeless Veteran subgroup specifically (AOR=1.51, 95% CI: 1.30-1.75). This persisted in the presence of several covariates, including sex, ethnicity, rurality, VA service-connected disability, posttraumatic stress disorder, depression, and VHA mental health and general service use. NHPI homeless Veterans were also significantly less likely to utilize VHA services, suggesting an important gap in health service delivery. Results support potentially heightened risk for TBI among NHPI homeless Veterans, and a need to elucidate if such injuries occur during or outside of military service. Alternatively, given potential sociocultural differences, understanding the experience and expression of TBI sequelae among NHPI homeless Veterans is essential. Further research is requisite to understand how to optimally engage homeless NHPI Veterans in care to ensure TBI-related sequelae are adequately identified and addressed.

Abbreviations

AOR = adjusted odds ratio
CI = confidence interval
NHPI = Native Hawaiian and Pacific Islander
PTSD = posttraumatic stress disorder
TBI = traumatic brain injury
VA = Department of Veterans Affairs
VHA = Veterans Health Administration

Introduction

Traumatic brain injury (TBI) is a prevalent injury among individuals who have served in military conflicts.[1] TBI can result in lasting neurocognitive sequelae (eg, memory, executive dysfunction), leading to exacerbated psychosocial difficulty.[2] TBI is also highly comorbid with psychiatric conditions common among Veterans, including posttraumatic stress disorder (PTSD) and depression.[3,4] Moreover, the intersection of TBI with these psychiatric diagnoses is associated with financial difficulties, unemployment, and criminal legal system involvement.[5,6]

These factors are notable given their relation to homelessness. Of note, the prevalence of TBI among homeless Veterans is high,[7] with a cross-sectional study at 2 Veterans Affairs (VA) medical centers reporting that rates of TBI were nearly 91% among Veterans accessing homeless services.[8] However, it is largely unclear if TBI causally exacerbates trajectories to homelessness. Some, research suggests TBI is an independent and direct risk factor for homelessness.[9] In addition, TBI is also associated with indirect correlates of homelessness risk, such as financial challenges and unemployment.[9] A large prospective cohort study of transitioning service members identified TBI as being predictive of homelessness among some subgroups of Veterans, although this association was complicated by comorbid PTSD.[10] Nonetheless, the experience of homelessness, especially within unsheltered environments (eg, under an overpass, in a park), can increase risk for exposure to physical violence, including head injuries that can result in TBI.[9,11] This is further complicated by the fact that many individuals experiencing homelessness may have diminished access to care, which may result in delays obtaining TBI-related care. Such delays may impact the course of the brain injury, including both acute critical care needs (eg, brain bleed) and longer-term care (eg, neurocognitive and mental health symptoms).[9,11] As such, the relationship between TBI and homelessness is likely complex and bidirectional.[9]

Additionally, some segments of the homeless Veteran population remain understudied. For example, Native Hawaiian and Pacific Islander (NHPI) Veterans have his-

torically not been included within health research broadly due to various factors (eg, residing in US territories, inadequate sample size, lack of focused research on these populations).[12] Importantly, the VA has recently led epidemiologic efforts to elucidate rates of TBI, including comparison by race/ethnicity.[13] Although rates of TBI in the NHPI Veteran population do not appear elevated relative to other racial groups (eg, White Veterans), analyses were not specific to homeless Veterans.[13] Further, some research suggests NHPI Veterans experience trauma-related sequelae (eg, PTSD) and blast exposures with high propensity.[14, 15] Such exposures are notable as psychological trauma exposures, which can result in PTSD, have the potential to have concurrent physical traumatization (eg, physical assault, blast exposure), which can result in head injuries and, at times, a TBI.[16]

This limited research is further complicated by research tending to combine NHPI Veterans with those of other racial/ethnic identities (eg, Asian American Veterans). Indeed, recent research has suggested substantial heterogeneity between Asian American and NHPI Veteran populations, including differing risk for mental health sequelae.[14] Such an approach is further problematic given that NHPI Veterans often reside in high cost-of-living regions (eg, Pacific Islands) with more limited access to health and social services.[17,18] Further, many NHPI Veterans reside in rural regions (eg, Guam) which can serve as a barrier to accessing VA services, including specialty TBI-related care.[19] Finally, NHPI individuals have historically experienced generational traumas including loss of land with important cultural and familial ties. This has a notable impact on access to resources, including stable housing.[20]

To the authors' knowledge, no studies have examined if rates of TBI diagnosis among homeless Veterans differ between those who identify as NHPI versus those who do not. This study is an initial examination of TBI diagnosis among a national cohort of NHPI Veterans accessing Veterans Health Administration (VHA) homeless services. This analysis examined if there were differences in rates of TBI diagnosis between NHPI and non-NHPI homeless Veterans, including amongst the subsample of White homeless Veterans specifically.

Method

Participants and Procedures

The current study examined electronic medical record data of all Veterans accessing VHA homeless services between January 1, 2005 and December 31, 2018.[21] All data were obtained from VA Corporate Data Warehouse. Sociodemographic factors (ie, age, race, sex, ethnicity, rurality), service-connected disability (presence or absence), diagnoses (TBI, PTSD, depression), use of VHA mental health services, and use of VHA general services (ie, all VA services except mental health and homeless services)[21] were derived from Veterans' electronic medical records. Diagnoses were based on ICD-codes. Service use was based on relevant stop and bed section codes. As VHA service use was non-normally distributed, tertiles were formed for the entire sample based on number of total encounters each individual accessed from 2005-2018 for VHA use [low (⩽78); moderate (>78 and ⩽215); or high (>215) use] and VHA mental health care use [low (⩽17); moderate (>17 and ⩽93); or high (>93)].

The final cohort included 724 752 homeless Veterans. Of these, 1177 (0.2%) identified as NHPI. Comparator samples were generated for non-NHPI Veterans (n=723 575; 99.8%), and White Veterans (n=418 085; a subsample of the non-NHPI sample, which comprised 57.7% of the total sample and 57.8% of the non-NHPI Veteran sample). The current study was approved by the Colorado Multiple Institutional Review Board (#20-2756) and the local VA Research and Determinations committee.

Analytic Plan

Sample characteristics were generated for the NHPI and comparator cohorts (non-NHPI and White homeless Veterans). The 2 comparator samples (non-NHPI and White) were chosen to determine if the associations between NHPI race and TBI were specific to non-NHPI Veterans or only relative to White Veterans. As race and ethnicity were distinct variables in this sample (eg, White, non-Hispanic), Hispanic ethnicity was examined as a covariate to further delineate this association. Differences in sample characteristics were examined using chi-squared analyses. To examine if NHPI identity was associated with TBI diagnosis, crude logistic regression analyses were conducted. Adjusted logistic multivariate regressions were also conducted to determine if these associations remained significant when adjusting for covariates. Covariates included: rurality, age, sex, ethnicity, service-connected disability, PTSD, depression, VHA general use, and VHA mental health service use. Rurality, service-connected disability, and VHA service use (both general and mental health) were included as access and engagement in VHA services have been shown to be associated with greater likelihood of receipt of medical diagnosis, including TBI.[5] Sociodemographic factors (ie, age, sex, ethnicity) were included, as these factors are associated with propensity to encounter warzone experiences associated with TBI,[13] as well as social determinants associated with TBI diagnosis and receipt of care (eg, sex).[22] Finally, PTSD and depression were included in adjusted analyses given comorbidity as well as the intricate and neurologic relation of these diagnoses to TBI.[4] All analyses were conducted using IBM SPSS, Version 29.0 (IBM Corp, Armonk, NY).

Results

Table 1 includes sample characteristics for each cohort. Relative to both the non-NHPI and White cohorts, the NHPI cohort was significantly younger and included more females and those who resided in non-rural areas (P<.001). NHPI Veterans also were significantly less likely to have documentation of service-connected disability (P=.007 [vs. non-NHPI] and P=.005 [vs. White]) and were more likely to be low users (vs. moderate or high) of VHA general care or VHA mental health services when compared to non-NHPI and White Veterans (all P<.001). NHPI Veterans were also

significantly more likely to have a PTSD diagnosis when compared to both the non-NHPI and White Veteran cohorts (*P*<.001). There were no significant differences between NHPI Veterans and the comparator cohorts in depression diagnosis. Although associations were largely similar between the non-NHPI and White cohorts, the White cohort was significantly more likely to identify as Hispanic (*P*=.007), relative to the NHPI cohort; in contrast, this was not observed in comparisons between the non-NHPI and NHPI cohorts.

NHPI Veterans had higher rates of documented TBI diagnosis (18.3%) relative to both the non-NHPI (10.9%) and White (12.9%) Veteran cohorts. Specifically, in the crude model, NHPI homeless Veterans were 82% more likely to have a documented TBI diagnosis relative to non-NHPI homeless Veterans (AOR=1.82, 95% CI: 1.57-2.11, *P*<.001), and 51% more likely compared to White homeless Veterans (AOR=1.51, 95% CI: 1.30-1.75, *P*<.001; **Table 2**). This effect persisted in the presence of several covariates, such that, in adjusted analyses, NHPI homeless Veterans were 48% more likely to have a TBI diagnosis compared to the non-NHPI cohort (AOR = 1.48, 95% CI: 1.27-1.74, *P*<.001), and 28% more likely to have a TBI diagnosis compared to the White cohort (AOR=1.28, 95% CI: 1.09-1.50, *P*=.003).

Discussion

This study is the first to examine TBI diagnosis among NHPI homeless Veterans relative to non-NHPI homeless Veterans. It is important to consider why NHPI homeless Veterans had higher rates of documented TBI diagnosis relative to these other Veterans. For example, a study by Sakamoto and colleagues found that NHPI Veterans have among the highest rates of deployment-related blast exposure,[15] with many experiencing posttraumatic amnesia, factors that are significant correlates of TBI severity and subsequent neurocognitive impact. Consequently, research is needed to understand when homeless NHPI Veterans experience TBI (eg, during deployment, post-deployment), including potentially during episodes of homelessness, and how these injuries impact functioning.

Finding regarding elevated rates of TBI among NHPI homeless Veterans suggest these Veterans may warrant increased attention to inform delivery of TBI-related services, such as rehabilitative services. Findings also suggest that an important next step is understanding psychodiagnostic practices as they relate to TBI assessment among NHPI homeless Veterans. Culturally-sensitive approaches that consider the intersection of NHPI identity and housing instability may be important for conceptualizing cognitive symptoms. For example, some NHPI individuals are more likely to describe symptoms as physical complaints,[23] which may complicate the process of determining the etiology of somatic (headaches, concentration concerns) and psychiatric symptoms (sadness, anxiety).[24] Therefore, additional information, including how TBI diagnosis is determined and culture is integrated into case conceptualization, is necessary.

An incidental finding that warrants additional examination was the lower use of VHA services among NHPI homeless Veterans, which is concerning for multiple reasons. Individuals who do not present to care are less likely to be screened and evaluated for health conditions; thus, the finding of higher rates of TBI diagnosis despite lower VHA use is troubling. This may suggest rates of TBI are actually underestimated among NHPI homeless Veterans. Moreover, it is possible that some NHPI homeless Veterans were referred for VA care, yet did not access services. Additional research is needed to understand which services these Veterans are accessing, including TBI-related care, both within VA and the community.

Interestingly, prior research has been mixed regarding VA and community-based service use among NHPI Veterans. Some work has found no differences in service use among NHPI Veterans relative to other racial/ethnic groups of Veterans,[25] while other studies have found greater use of some VA services, including TBI-related care.[19] However, these studies examined the general NHPI Veteran population, rather than those experiencing homelessness, or aggregated data from Veterans who identified as NHPI and Asian American. In addition, some research has noted that Asian American and Pacific Islander Veterans are more likely to have private insurance than other cohorts (eg, Black Veterans).[25] Although it is less likely that homeless Veterans have private insurance, it is possible that some NHPI homeless Veterans have access to other forms of insurance (eg, Medicaid), and therefore, access community care in lieu of VA services.

Although this finding regarding VA use was incidental, there are several potential explanations. VHA specialty services for TBI-related care (eg, neurorehabilitation) may be more limited or difficult to access in regions with high concentrations of NHPI Veterans (eg, Guam).[14] As such, Veterans in these regions may have to travel to distant areas which may result in substantial financial burden (eg, transportation and lodging costs; childcare costs). Toward this end, Veterans in rural regions (eg, Guam) or experiencing psychosocial stressors (eg, homelessness) may lack financial resources to access or obtain specialty care, including TBI-related care, in distant, high-cost-of-living areas on O‘ahu or the continental US.[26,27] Further, NHPI Veterans in rural and underserved regions may access non-VA care if it is more readily available or if there is more local knowledge regarding services (eg, community-based case manager, spiritual leader).[28] Finally, prior experiences with the federal government may engender perceptions of structural racism and distrust, potentially contributing to lower use of VA services.[14,29]

Mental health stigma among NHPI individuals also may serve as a barrier to service use.[23,24] NHPI Veterans may engage in traditional cultural healing practices (eg, *ho‘oponopono*; *lomi lomi; la‘au lapa‘au*), rather than a “westernized” biomedical approach, although this warrants further research as it is unknown how homeless NHPI Veterans view available VA practices.[14,28] Similarly, some NHPI Veterans may prefer to access support through individuals

Table 1. Characteristics and Group Differences for NHPI, non-NHPI, and White Veterans accessing Department of Veterans Affairs Homeless Programs between January 1, 2005 and December 31, 2018.

	NHPI Cohort (*n*=1177)		Non-NHPI Cohort (*n*=723575)		χ^2 for NHPI vs. Non-NHPI Cohort[a]		White Cohort (*n*=418085)		χ^2 for NHPI vs. White Cohort[a]	
	n	%	*n*	%		*P*	*n*	%		*P*
Age					833.37	<.001			792.34	<.001
≤ 39	569	48.3	141,976	19.6			85,398	20.4		
40-49	245	20.8	96,108	13.3			55,593	13.3		
50-59	234	19.9	175,060	24.2			93,808	22.4		
60-69	104	8.8	220,216	30.4			121,659	29.1		
≥ 70	25	2.1	90,215	12.5			61,627	14.7		
Sex					76.52	<.001			136.25	<.001
Male	939	79.8	637,168	88.1			376,315	90.0		
Female	238	20.2	86,407	11.9			41,770	10.0		
Hispanic	93	7.9	58,561	8.1	.06	.809	43,031	10.3	7.27	.007
Rural	98	8.3	88,695	12.3	16.90	<.001	67,325	16.1	52.60	<.001
Service-connected disability	71	6.0	59,234	8.2	7.26	.007	34,707	8.3	7.94	.005
TBI	215	18.3	79,053	10.9	65.02	<.001	53,817	12.9	30.42	<.001
PTSD	609	51.7	293,156	40.5	61.45	<.001	175,338	41.9	46.32	<.001
Depression	694	59.0	427,063	59.0	<.01	.970	255,806	61.2	2.44	.118
VHA general use[b]					243.59	<.001			242.15	<.001
Low	624	53.0	240,007	33.2			138,133	33.0		
Moderate	359	30.5	241,479	33.4			142,423	34.1		
High	194	16.5	242,089	33.5			137,529	3.9		
VHA mental health use[c]					97.81	<.001			93.32	<.001
Low	472	40.1	240,526	33.2			136,817	32.7		
Moderate	472	40.1	241,367	33.4			143,258	34.3		
High	233	19.8	241,682	33.4			138,010	33.0		

[a]Chi-square analyses were conducted between NHPI and non-NHPI homeless Veteran cohorts as well as NHPI and White homeless Veteran cohorts.
[b]VHA general use computed based on total number of encounters as: low (≤78); moderate (>78 and ≤215); and high (>215) use.
[c]VHA mental health use computed based on total number of encounters as: low (≤17); moderate (>17 and ≤93); and high (>93).
Abbreviations: NHPI = Native Hawaiian and/or Pacific Islander; PTSD = posttraumatic stress disorder; TBI = traumatic brain injury; VHA = Veterans Health Administration.

Table 2. Crude and Adjusted Models Examining Associations Between NHPI Identity and TBI Diagnosis among Veterans accessing Department of Veterans Homeless Programs between January 1, 2005 and December 31, 2018.

Variable	NHPI vs. Non-NHPI			NHPI vs. White		
	AOR	95% CI	*P*	AOR	95% CI	*P*
Crude						
NHPI identity	1.82	1.57, 2.11	<0.001	1.51	1.30, 1.75	<0.001
Adjusted						
NHPI identity	1.48	1.27, 1.74	<0.001	1.28	1.09, 1.50	0.003
Age[a]						
40-49	0.51	0.50, 0.52	<0.001	0.51	0.49, 0.52	<0.001
50-59	0.30	0.30, 0.31	<0.001	0.31	0.30, 0.32	<0.001
60-69	0.23	0.23, 0.24	<0.001	0.24	0.23, 0.24	<0.001
≥ 70	0.19	0.18, .19	<0.001	0.18	0.17, 0.19	<0.001
Sex[b]	2.26	2.20, 2.32	<0.001	2.16	2.09, 2.24	<0.001
Ethnicity[c]	1.14	1.11, 1.17	<0.001	1.02	0.99, 1.05	0.314
Rural[d]	1.11	1.08, 1.13	<0.001	1.03	>0.99, 1.05	0.065
Service-connected disability[e]	1.21	1.18, 1.24	<0.001	1.23	1.19, 1.27	<0.001
PTSD	2.66	2.61, 2.71	<0.001	2.74	2.68, 2.80	<0.001
Depression	1.32	1.28, 1.35	<0.001	1.26	1.23, 1.29	<0.001
VHA general use[f]						
Moderate	1.80	1.76, 1.85	<0.001	1.80	1.74, 1.86	<0.001
High	3.06	2.96, 3.16	<0.001	3.09	2.97, 3.21	<0.001
VHA mental health use[g]						
Moderate	1.31	1.28, 1.35	<0.001	1.32	1.28, 1.37	<0.001
High	1.26	1.22, 1.30	<0.001	1.28	1.23, 1.33	<0.001

[a]Age ≤ 39 selected as reference.
[b]Male sex selected as reference.
[c]Hispanic ethnicity selected as reference.
[d]Residing in a rural region selected as reference.
[e]Presence of service-connected disability selected as reference.
[f]Low VHA general service use selected as reference.
[g]Low VHA mental health service use selected as reference.
Note. Binomial logistic regression models conducted for all crude and adjusted regressions. All models were significant.
Abbreviations: AOR = adjusted odds ratio; CI = confidence interval; NHPI = Native Hawaiian and/or Pacific Islander; PTSD = posttraumatic stress disorder; TBI = traumatic brain injury; VHA = Veterans Health Administration.

within their communities, such as family members, friends, peers, or spiritual leaders.[14]

The intersection of demographic and cultural factors also may have impacted use of VA services among NHPI Veterans, who were more likely to be female. Females traditionally are more likely to have caretaking duties (eg, children, older family members),[30] and this is especially true amongst NHPI individuals in which collectivistic ideals, including caretaking of older family members, is more normative.[31] Such factors can impact ability to access VA services, including specialty care which can be time-intensive (eg, psychotherapy). Additionally, multiple other barriers to VA healthcare use have been noted for female Veterans (eg, lack of gender-sensitive options, feeling uncomfortable) that are important to consider.[32] Therefore, examining the intersection of gender as it relates to NHPI race is important for future work in this domain.

Finally, an important note is the discrepancy between prior work documenting rates of TBI as high as 91% among Veterans experiencing homelessness[10] and this study's finding of 10.9%-18.3%. Several factors may explain this discrepancy, including that the prior study administered a diagnostic interview in a non-TBI-related service setting while this study examined VA electronic medical records, which necessitated the Veteran having received a documented diagnosis. Some Veterans experiencing homelessness may not have gone through the formal process to be diagnosed with a TBI (which can occur in TBI-related service settings), which could partially explain this discrepancy. Nonetheless, given the magnitude of difference in TBI diagnostic rates, additional work is requisite to understand why differences in rates may occur between VA electronic medical records and diagnostic interviews.

Limitations

Findings were based on VA electronic medical records and diagnoses were not confirmed via clinical interview. Some

factors were not readily available in this dataset (eg, private insurance, branch of service, specialty) which may be related to findings. TBI diagnosis was not differentiated based on severity (ie, mild, moderate, severe).[5,21] This is an important consideration as moderate/severe TBIs have differing repercussions and treatment approaches.[33] Homelessness was defined based on use of VHA homeless programs; as such, a portion of homeless Veterans (ie, those experiencing homelessness who had not accessed VHA homeless program services) may not be captured in this cohort.

NHPI race was extracted from VA electronic medical records and may not reflect how Veterans identified themselves. Indeed, Hernandez and colleagues[34] have noted that NHPI data extraction from VA electronic medical record may be poor relative to other racial/ethnic groups (eg, White Veterans). The broad NHPI category also did not allow for disaggregation; as such, differences between specific NHPI cultural groups could not be examined, despite heterogeneity between these groups. Multi-racial identity was also not categorized in analyses such that NHPI Veterans who were multi-racial were classified as NHPI. As many NHPI individuals are multi-racial,[35] with a substantial portion also identifying as Asian American, further disaggregation is necessary, particularly considering that Veterans who identify as both Asian American and NHPI appear to have higher rates of adverse health outcomes (eg, suicidal ideation).[36] In addition, given the transient nature of homelessness, it was not possible to examine the impact of region (eg, Pacific Islands relative to mainland), including if differences in rates of TBI diagnosis remained significant after accounting for region of residence. The smaller size of the NHPI cohort, compared to the non-NHPI and White cohorts, also may have impacted analyses; as such, analyses should be viewed as preliminary, with replication in a larger cohort warranted. This was also a secondary analysis of an existing dataset and data were not available beyond 2018 (including through the COVID-19 pandemic, during which housing instability was impacted).[37] Consequently, findings may differ in the more recent years, especially given factors impacting VA service use and housing instability (eg, COVID-19 pandemic). Examination with a more contemporary dataset is warranted.

It is also important to note that NHPI Veterans are disproportionately located within the US Pacific Islands and the West coast of the United States.[38] As such, these Veterans may be more likely to access VA care from VA facilities within these regions (eg, medical centers in Honolulu, San Diego, Las Vegas), which may may differ in their TBI-related assessment and care relative to other VA facilities. Nonetheless, this assertion is speculative in nature. As the teams was unable to account for specific VA facilities or facility types in our analyses, further examination of the region or facility where care was delivered may be important to include in future examinations of NHPI race and TBI among homeless Veterans.

Conclusions

This project serves as an initial examination suggesting higher documented rates of TBI diagnosis among NHPI homeless Veterans. Given lower rates of VHA service utilization among NHPI homeless Veterans, findings suggest a need to understand how to connect and engage NHPI homeless Veterans into care, especially TBI-related services. Future research focused on understanding culturally-sensitive methods of assessing TBI and facilitating engagement in services among NHPI homeless Veterans is paramount.

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