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Health-related quality of life among veterans in addictions treatment: identifying behavioral targets for future intervention

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Abstract
Background US veterans report lower health-related quality of life (HRQoL) relative to the general population. Identifying behavioral factors related to HRQoL that are malleable to change may inform interventions to improve well-being in this vulnerable group.
Purpose The current study sought to characterize HRQoL in a largely male sample of veterans in addictions treatment, both in relation to US norms and in association with five recommended health behavior practices: regularly exercising, managing stress, having good sleep hygiene, consuming fruits and vegetables, and being tobacco free.
Methods We assessed HRQoL with 250 veterans in addictions treatment (96 % male, mean age 53, range 24–77) using scales from four validated measures. Data reduction methods identified two principal components reflecting physical and mental HRQoL. Model testing of HRQoL associations with health behaviors adjusted for relevant demographic and treatment-related covariates.
Results Compared to US norms, the sample had lower HRQoL scores. Better psychological HRQoL was associated with higher subjective social standing, absence of pain or trauma, lower alcohol severity, and monotonically with the sum of health behaviors (all $p < 0.05$). Specifically, psychological HRQoL was associated with regular exercise, stress management, and sleep hygiene. Regular exercise also related to better physical HRQoL. The models explained >40 % of the variance in HRQoL.
Conclusions Exercise, sleep hygiene, and stress management are strongly associated with HRQoL among veterans in addictions treatment. Future research is needed to test the effect of interventions for improving well-being in this high-risk group.

Keywords Health behaviors · Health-related quality of life · Veterans · Substance abuse

Introduction

Health-related quality of life (HRQoL) is a patient-reported measure of health status, assessing states of mind and states of body. The CDC defines HRQoL as multidimensional, encompassing subjective evaluations of positive and negative aspects of life clearly shown to affect either physical or mental health [1–3]. Over the past three decades, many measures of HRQoL have been developed, ranging in generality versus specificity [4]. They include preference-based measures for estimating quality-adjusted life-years; more general assessments of physical and/or psychological functioning; and measures of depression and mood [5]. As a global concept, HRQoL has proven to be useful for identifying groups at risk for morbidity and premature mortality and in need of intervention [6, 7].

In particular, research has been conducted to report on the health outcomes and functional status of US veterans [8]. For example, Kazis et al. [9] in their study with 1667 veterans recruited from VA ambulatory care clinics reported substantially worse mental and physical health

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status relative to non-VA populations and particularly poor HRQoL among younger respondents. In contrast, studies in non-veteran samples have reported poorer HRQoL among older versus younger adults, although mental quality of life scores peak in the 60-year-old to 79-year-old age group [10, 11]. Low HRQoL in veteran samples may in part be attributed to service-related trauma exposure [12, 13]; debilitating pain [14]; and substance abuse [15, 16]. HRQoL also has been found related to socioeconomic status (SES) indicators and race/ethnicity. Notably, subjective self-rated SES (e.g., perceived social status in the USA or in one's community) has been a stronger predictor of health status and decline in health over time than traditional objective SES indicators of education and income [17]. Racial/ethnic differences in health exist [18, 19], although patterns of HRQoL are mixed, with some studies showing higher HRQoL for African-American adults compared to Whites [20], while others finding the reverse [21, 22], and in some cases specifically among African-American women [23]. Differences in findings may relate in part to differences in HRQoL measurement.

Beyond static demographic and clinical factors, of interest for intervention are modifiable factors or behaviors that may affect HRQoL in positive ways. Regular aerobic exercise, for example, is associated with positive mental and physical health [24, 25]; stress has been implicated in numerous diseases and inflammatory pathways [26–30]; adequate sleep is associated with physical and mental health [31, 32]; eating fruits and vegetables is recommended for and associated with overall health [33, 34]; and smoking is the leading preventable cause of disease, disability, and death [35, 36]. In our earlier studies of non-veteran clinical samples (i.e., smokers with mental illness or addictive disorders), clustering of multiple risk behaviors (e.g., poor diet, alcohol and drug, exercise, stress management, sleep hygiene) was associated with worse mental and physical health functioning [37]. Identification of key health-supporting behaviors associated with HRQoL can help inform future interventions.

The current study investigated how health behaviors relate to HRQoL among veterans in addictions treatment. Identifying the modifiable health behaviors that have the strongest association with HRQoL scores can inform prioritization for behavior change interventions.

Methods

Study design

Information on quality of life and health behaviors was assessed at baseline in a randomized trial of a multiple health behavior change intervention with veterans in addictions treatment. The intervention was tailored to stage of change, and participants were not required to want to change a risk behavior to participate. Study recruitment has been described previously [38]. The current analyses examined baseline self-reported HRQoL and engagement in health behavior practices.

Sample

Participants were adult veterans (≥18 years of age) recruited from addiction treatment clinics at the San Francisco Veterans Affairs Medical Center who planned to remain in the San Francisco Bay Area over the next 18 months. Exclusion criteria were unstable psychosis, mania, or a disabling organic mental disorder. Inclusion criteria were purposefully broad with minimal exclusion criteria in order to maximize generalizability.

Measures

We defined HRQoL to include positive mental and physical functioning, as well as the absence of mood and emotional disturbance. We used four validated measures of HRQoL:

1. *The Profile of Mood States (POMS)* is an established and valid measure of mood [39]. We used the E-POMS, a 30-item abbreviated and established version [40]. Participants rated the extent that they experienced 30 different feelings during the past week on a 5-point Likert scale (not at all, a little, moderately, quite a bit, extremely). The 30 feelings were summed and categorized into scales reflecting Tension, Depression, Anger, Fatigue, Confusion, and Vigor. The Total Mood Disturbance was calculated by summing up the first five categories and subtracting the Vigor score.
2. *Standard Short Form-12 (SF-12v2)* is a validated survey with 12 questions adapted from the SF-36 Health Survey [11]. The physical component scores (PCS) and mental component scores (MCS) range from 0 (lowest level of health functioning) to 100 (highest level of health functioning), with a population norm of 50 and standard deviation of 10 [41].
3. *Center for Epidemiologic Studies Depression Scale (CESD)* is a validated, 10-item measure of past week depression symptoms. Scores ≥ 10 are considered indicative of depression [42].
4. *Health Utility Index 3 (HUI3)* is a multi-attribute preference-based measure of health status and HRQoL yielding eight attributes, or dimensions, of health status [43]. Scores range from highly impaired or disabled (0) to normal (1). We used scores from the four attributes most likely to be directly affected by, or related to, our

health behavior assessment: Cognition, Emotion, Ambulation, and Pain. The other scales of Vision, Hearing, Speech, and Dexterity were deemed as less modifiable via health behavior change and hence less relevant to our study purposes. For comparison with the general population, we also used the HUI3 Multi-Attribute Utility Score, a composite based on the 8 attributes of Cognition, Emotion, Ambulation, Pain, Vision, Hearing, Speech, and Dexterity.

Staging Health Risk Assessment (S-HRA), developed by ProChange Behavior Systems (South Kingstown, RI), measures engagement in the following health behaviors: regular exercise (i.e., planned physical activity that increases breathing rate and causes light sweat 5–7 times per week for at least 30 min per day), stress management (i.e., effective practices in daily life regular relaxation, physical activity, talking with others, and/or making time for social activities), sleep hygiene (i.e., getting at least 7 h of sleep, avoiding caffeine, alcohol, and nicotine close to bedtime, maintaining regular bed and wake schedule, and creating a sleep conducive environment that is dark, quiet, comfortable, and cool), fruit and vegetable consumption (i.e., eating at least five servings daily), and being tobacco smoke-free. Behavioral criteria were based on the Healthy People 2020 goals for the nation [44].

Demographic measures of interest included age; gender; race/ethnicity dichotomized as non-Hispanic White vs others due to a broad spectrum of ethnic minorities in our sample; and subjective SES assessed with the validated MacArthur Scale of Subjective Social Status [45]. The MacArthur scale presents a pictorial representation of a 10-rung ladder anchored at the top (10) with best jobs, most money, and most education and at the bottom (1) with the worst or no jobs, least money, and least education.

Treatment-related measures of interest were trauma exposure, screened using 3 questions from the Mini-International Neuropsychiatric Interview (MINI), a validated diagnostic interview for DSM-IV and ICD-10 psychiatric disorders [46], and alcohol and drug use severity assessed with the validated Addiction Severity Index (ASI) [47]. ASI scores range from 0 to 1; substance dependence cutoff scores for men range from 0.17 to 0.19 for alcohol dependence and 0.11–0.16 for drug dependence, and, respectively, for women are 0.13 and 0.12–0.18 [48].

Analytic plan

Descriptive statistics for the veterans were calculated for each of the HRQoL measures with values compared to US norms when available. Next, in order to simplify interpretation and still retain the unique information from all four HRQoL measures, we ran a principal component analysis to find the minimum number of measurement dimensions that distinguished HRQoL. We identified two independent factors measuring mental health (mental, emotional, and cognitive function and dysfunction) and physical health. Principal component analysis transforms the original variables into a new set of minimally correlated factors (principal components) that account for the maximum proportion of the variance in the data, with each component being a linear combination of the original observed variables. The first principal component is the linear combination of variables that accounts for the largest proportion of variance in the data, and the second component is the combination that accounts for the next largest proportion, and so on. Only components with eigenvalues (the sum of the squared factor loadings, representing the variance attributable to each principal component) >1.0 are considered significant.

We examined sample frequencies for each health behavior recommendation and summed the total number of health behaviors that each individual performed with a range of 0 (no health behaviors performed at criterion) to 5 (meeting criteria for all health behaviors of interest). In model testing, we performed one-way analyses of covariance, controlling for potential confounders, to examine the association of our health behavior sum index with the two identified HRQoL components. Included covariates were age, ethnicity/race, perceived subjective SES, severity of substance abuse, trauma exposure, and pain as assessed with the HUI3.[1] Due to the unequal sample sizes in the factors for the model, we used Type III sums of squares, which weight all cells the same regardless of sample size. Finally, to examine the association of *specific* lifestyle behaviors (rather than the sum of behaviors) with HRQoL, we conducted one-way analyses of covariance, controlling for the same confounders in the previous analyses. In model testing, missing data for various measures were excluded listwise, resulting in sample sizes between 235 (lowest sample size in analysis) and 250 (full sample).

Results

Sample description

Actively in addictions treatment at a veterans healthcare system, we recruited the 250 participants from a general outpatient drug and alcohol clinic (31 %), an intensive day-hospital program (28 %), an opioid treatment clinic

[1] While pain is often considered one of the domains of HRQoL, it also has a strong influence on other facets of HRQoL and is likely to be associated with our health behaviors of interest including physical activity and sleep. Therefore, we included pain as a covariate in our models rather than as an outcome.

(27 %), an access center transition group (8 %), a substance use clinic for clients with posttraumatic stress disorder (4 %), or other (1 %). The sample's average age was 52.7 (10.0) ranging from age 24 to 77; few were women ($n = 9$); 44.8 % identified as non-Hispanic White. Mean (SD) addiction severity index scores were 0.11 (0.09) for drugs and 0.17 (0.16) for alcohol, each of which meet the cutoff scores for dependence [48]. Over a third (36 %) reported trauma exposure.

On the four measures of HRQoL, a majority of participants reported poor functioning. CESD depression scores averaged 13.02 (7.00), with 68 % of the sample scoring ≥ 10, indicating significant depressive symptoms. The E-POMS Total Mood Disturbance score averaged 26.68 (22.49) (no norms available). On the SF-12v2, our sample scored significantly worse for both physical and mental health functioning relative to US population norm values for men aged 45–54 and 55–64 (Table 1). Figure 1 shows the frequencies of participants at each level of the HUI3 constructs of interest relative to the US population [20], from normal (level 1) to disabled (levels 4, 5, 6). A lower percentage of veterans in our sample were classified as normal and a higher percentage were categorized as disabled on the HUI3 scales of interest (see frequencies in Fig. 1). On the HUI3 Multi-Attribute Utility Score, the sample had a mean of 0.53 (0.31), which is significantly lower than the general US adult population score of 0.81 (0.64), t (4282) = 6.70, $p < 0.001$ [20].

For the health behavior practices assessed, the proportion meeting criterion was: 77 % for practicing stress management, 64 % for good sleep hygiene, 47 % for regularly exercising, 46 % for non-smoking, and 36 % for daily consumption of 5 or more servings of fruits and vegetables. Only 7 % of the sample met criteria for all five measured health behaviors, 19 % met four, 32 % met three, 24 % met two, 13 % met one, and 4 % did not meet criteria for any of the assessed health behaviors.

Principal component analysis of HRQoL

Principal component analysis on the E-POMS, SF-12, CESD, and HUI3 constructs of Emotion, Cognition, and Ambulation ($n = 243$ with complete data) met three assumptions to justify this data reduction. First, all 7 of the assessment scores correlated at least 0.3 with at least one other score, suggesting reasonable factorability. Second, the Kaiser–Meyer–Olkin measure of sampling adequacy was 0.79, above the commonly recommended value of 0.6, and the Bartlett's test of sphericity was significant (x^2 (21) = 894.63, $p < 0.001$). Interpretations of the two principal component factors indicated that the first was an indicator of psychological HRQoL and the second was an indicator of physical HRQoL. The component and coefficient matrices are given in Table 2. Composite scores were created for each of the two factors, with higher scores indicating healthier and more positive life quality in that area.

Model testing

Number of health behaviors and HRQoL principal component scores

For the psychological HRQoL principal component, the full model was significant, $F_{(12,213)} = 12.04$, $p < 0.001$, adjusted $R^2 = 0.37$, and the number of health behaviors was significantly associated $F_{(5,213)} = 3.38$, $p = 0.006$. There was a monotonic trend found in that the more health behaviors met, the higher the psychological HRQoL principal component score (Fig. 2). Covariates of pain, ASI—alcohol, trauma exposure, age, and subjective SES were all significant at $p \leq 0.05$; and ASI—drug, ($p = 0.23$), and race/ethnicity ($p = 0.21$) were not statistically significant. Higher psychological HRQoL was associated with less pain, less alcohol addiction severity, no trauma exposure, older age, and higher subjective SES.

For the physical HRQoL principal component, the model $F_{(12,213)} = 12.34$ and covariates of age and HUI3 pain were all significant at $p \leq 0.01$, adjusted $R^2 = 0.38$. However, the number of health behaviors was not significantly associated, $F_{(5,213)} = 0.39$, $p = 0.85$; nor were alcohol ($p = 0.20$) or drug ($p = 0.89$) addiction severity, trauma exposure ($p = 0.14$), race/ethnicity ($p = 0.99$), or subjective SES ($p = 0.66$). Lower physical HRQoL was associated with greater age and greater pain.

Table 1 Means (SDs) of SF-12v2 scores for the sample versus US population norms for men aged 45–54 and 55–64

	Sample ($n = 88$)	US norms, males 45–54 ($n = 560, 558$)	t (df)	Sample ($n = 94$)	US norms, males 55–64 ($n = 408$)	t (df)
PCS	45.47 (11.30)	50.54 (9.56)	t (646) = 4.51***	42.93 (10.69)	47.57 (9.91)	t (500) = 4.03***
MCS	38.25 (10.61)	50.16 (9.81)	t (644) = 10.46***	41.28 (11.74)	51.61 (9.15)	t (500) = 9.32***

Samples are subsets with only males in the norms comparison age range

PCS physical component score, *MCS* mental component score

*** $p < 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$

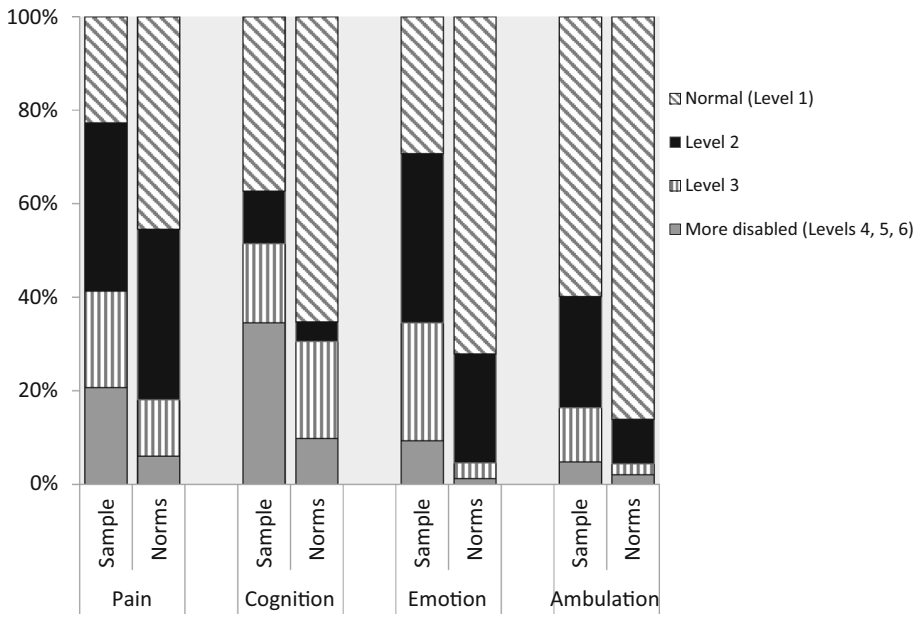

Fig. 1 Health Utilities Index 3 percentages for sample versus US population norms

Table 2 Component and coefficient matrix for principal component analysis

HRQoL measure	Component		Coefficient	
	1	2	1	2
Emotion (HUI3)	*0.774*	−0.019	0.223	0.017
Cognition (HUI3)	*0.683*	0.043	0.192	0.053
Mood Disturbance (E-POMS)	*−0.920*	−0.036	−0.260	−0.057
Depression (CESD)	*−0.920*	0.061	−0.268	0.003
Mental component score (MCS)	*0.808*	−0.349	0.260	−0.186
Ambulation (HUI3)	0.177	*0.834*	−0.018	0.523
Physical component score (PCS)	0.161	*0.881*	−0.026	0.552

Principal components derived using varimax with Kaiser normalization; italic indicates highest loadings for the component matrix

HUI3 Health Utilities Index 3, *E-POMS* Profile of Mood States, *CESD* Center for Epidemiologic Studies Depression Scale

Specific health behaviors and HRQoL principal component scores

Participants who practiced regular exercise scored higher on both psychological and physical HRQoL, the only health behavior significantly associated with both factors (Table 3). Stress management had the strongest association with psychological HRQoL, and both practicing stress management and good sleep hygiene were associated with better psychological HRQoL. Neither stress nor sleep hygiene related to physical HRQoL, and eating five fruits and vegetables per day and being tobacco-free were unrelated to both HRQoL components. For the measured covariates, older age, less pain, lower alcohol addiction severity, higher subjective SES, and no trauma exposure were associated with higher psychological HRQoL, while younger age and less pain were related to greater physical HRQoL.

Discussion

In our sample of veterans in addictions treatment, HRQoL measures of mental and physical functioning were significantly lower than US population norms. When adjusting for age, pain, addiction severity, race/ethnicity, subjective SES, and trauma exposure, those who engaged in multiple health behaviors had higher scores on psychological measures of quality of life. This dosing association is interesting, as two of the five behaviors (fruit and vegetable intake and smoking status) did not relate significantly on their own. While causality cannot be

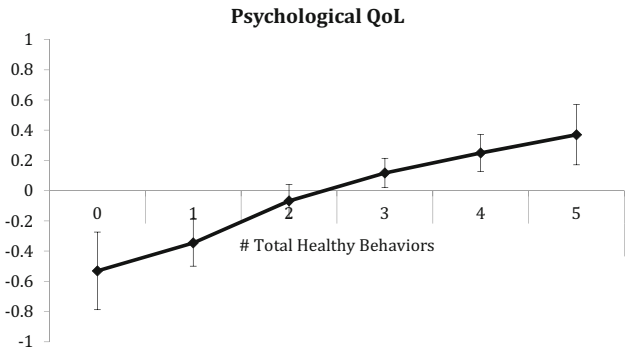

Fig. 2 Relationship of psychological health-related quality of life (QoL) principal component by the number of healthy behaviors met. Means for each number of health behaviors are conditional point estimates; *error bars* are pointwise standard errors. *Note* Principal components are standardized to a mean of 0 and SD of 1

determined here, a possible explanation for the relationship may be that healthy behaviors synergistically enhanced psychological benefits when co-occurring. The number of health behaviors in which participants engaged was unassociated with physical functioning quality of life measures.

When we examined the specific health behaviors, the difference in psychological HRQoL scores was largest between those who reported successfully managing stress versus those who did not. This item listed several examples of stress management methods, including daily regular relaxation, physical activity, talking with others, and/or making time for social activities. Future investigations should assess which specific stress management strategies are predominantly chosen and related to HRQoL.

Regular exercise, assessed alone as a health-supporting behavior, was associated with both better psychological and physical HRQoL. Physical activity interventions have found significant effects on psychological well-being. For example, mental component scores from the SF-12 (QoL measure) improved by 11 points in a randomized controlled trial of aerobic and strength training exercise [49]. Additionally, cross-sectional studies have found associations between physical activity and mental health [50], as well as stage of change in exercise behavior and mental health functioning [51]. Physical functioning and HRQoL measures also have been found related to meeting public health recommendations for exercise [24, 25], with the association stronger in clinical populations [52]. Lastly, sleep hygiene had a positive relationship with psychological HRQoL, even when adjusting for trauma exposure, which has been associated with sleep disturbance [53].

Surprisingly, fruit and vegetable consumption and smoking status in this sample were unrelated to psychological and physical HRQoL both in multivariate model testing and in separate univariate tests of association (data not shown). The current study did not assess serum cholesterol, blood pressure, or other biological measures that diet and smoking have been consistently found to

Table 3 Analysis of covariance of specific health behaviors on psychological and physical health-related quality of life

	Psychological HRQoL principal component	Physical HRQoL principal component
	Adjusted *R* Sq	
Omnibus	0.44	0.41
Covariates	Partial eta squared	
Age	0.03*	0.06***
Pain Free (HUI3)	0.05***	0.26***
Alcohol addiction severity (ASI)	0.02*	0
Drug addiction severity (ASI)	0.01	0
Race/ethnicity	0	0
Subjective SES (MacArthur Scale)	0.07***	0
Trauma exposure (MINI)	0.03**	0.01
Independent factors (S-HRA)	Beta (standard error)	
Regular exercise	0.22 (0.11)*	0.33 (0.11)**
Practices stress management	0.66 (0.13)***	−0.16 (0.13)
Practices sleep hygiene	0.31 (0.11)**	−0.16 (0.11)
Eats 5 servings of fruits and vegetables	−0.08 (0.11)	0.12 (0.11)
Non-smoker	−0.14 (0.11)	0.01 (0.11)

HUI3 Health Utilities Index 3, *ASI* Addiction Severity Index, *MINI* Mini-International Neuropsychiatric Interview, *S-HRA* Staging Health Risk Assessment

*** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$

affect [54–56]. Fruit and vegetable intake has been associated with improved HRQoL [57] and higher life satisfaction [58]; however, accurate recall and assessment of dietary intake are difficult to achieve and particularly so with a single item. With regard to smoking, our previous work has found strong associations between heavier smoking and poorer health functioning [37]. In our sample, current smokers were on average 5 years younger than former and never smokers, and older age was associated with poorer physical health functioning. Prior research has found that poor health is predictive of quitting smoking [59]. Therefore, it could be that many former smokers in our sample had quit due to poor HRQoL, thereby muting effects.

Given the cross-sectional nature of the data, no direction of causality can be determined. However, the current findings indicate that engagement in healthy lifestyle behaviors of stress management, sleep hygiene, and physical activity is associated with better quality of life in a veteran sample with multiple comorbidities. Worth testing is whether interventions that encourage and support the adoption of multiple healthy behaviors during addictions treatment improve HRQoL with particular attention to stress management and regular exercise. Enhancement of quality of life in this at-risk population is of national importance.

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Compliance with ethical standards

Conflict of interest None of the authors have conflicts of interest.

Ethical responsibilities of the authors All authors provided consent to submit this paper, and the authors whose names appear on the submission have significantly contributed to the scientific work and therefore share collective responsibility and accountability for the results. This manuscript has not been submitted to any other journal and has not been partly or fully published previously, and no data were fabricated. If requested to share relevant documentation of the IRB or raw data to verify the validity of the results, we will send it.

Ethical approval/informed consent All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Ethics review boards for UCSF, SF VAMC, and Stanford approved the study procedures, and all participants provided informed consent.

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