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Hoarding disorder is associated with self-reported cardiovascular / metabolic dysfunction, chronic pain, and sleep apnea

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Abstract

Hoarding behaviors are positively associated with medical morbidity, however, current prevalence estimates and types of medical conditions associated with hoarding vary. This analysis aims to quantify the medical morbidity of hoarding disorder (HD). Cross-sectional data were collected online using the Brain Health Registry (BHR). Among 20,745 participants who completed the Hoarding and Clutter and Medical History thematic modules, 1,348 had HD (6.5%), 1,268 had subclinical HD (6.1%), and 18,829 did not meet hoarding criteria (87.4%). Individuals with HD were more likely to report a lifetime history of cardiovascular/metabolic conditions: diabetes (HD adjusted odds ratio (AOR):1.51, 95% confidence interval (CI):[1.20, 1.91]; subclinical HD AOR:1.24, 95% CI:[0.95, 1.61]), and hypercholesterolemia (HD AOR:1.24, 95% CI:[1.06, 1.46];

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subclinical HD AOR:1.11, 95% CI:[0.94, 1.31]). Those with HD and subclinical HD were also more to report chronic pain (HD AOR: 1.69, 95% CI:[1.44, 1.98]; subclinical HD AOR: 1.44, 95% CI:[1.22, 1.69]), and sleep apnea (HD AOR: 1.58, 95% CI:[1.31, 1.89]; subclinical HD AOR:1.30, 95% CI:[1.07, 1.58]) than non-HD participants. For most conditions, likelihood of diagnosis did not differ between HD and subclinical HD. Structural equation modeling revealed that more severe hoarding symptomatology was independently associated with increased cardiovascular/metabolic vulnerability. The assessment and management of medical complications in individuals with HD is a fundamental component in improving quality of life, longevity, and overall physical health outcomes.

Keywords

Hoarding; Hoarding Disorder; Medical Comorbidity; Cardiovascular Health; Chronic Pain; Sleep

Introduction

Hoarding Disorder (HD) is characterized by a persistent difficulty discarding possessions, resulting in a debilitating accumulation of clutter in active living and/or work spaces (American Psychiatric Association, 2013; Ayers et al., 2010). Although hoarding behaviors can occur in the context of medical or psychiatric disorders such as dementia or schizophrenia, hoarding disorder is a chronic psychiatric condition independent of these illnesses. Clinically relevant hoarding behavior has a substantial negative impact on individuals, their caregivers, and the community (Ayers et al., 2010). Unlike hoarding due to organic causes, hoarding behaviors in the context of HD are generally purposeful in nature (i.e. there are specific motivation or value attached to possessions; (Frost & Steketee, 2014; Pertusa, Gaston, & Choudry, 2019), and contribute to substantial functional impairment as a result of limited activity involvement, low financial satisfaction, difficulty managing household and family demands, poor treatment outcomes and a higher frequency of suicide attempts (Chakraborty et al., 2012; Matsunaga et al., 2010; Vorstenbosch et al., 2012; Rosa et al., 2012). Furthermore, hoarding-related clutter in the home significantly increases fall risk, health code violations, and difficulty with self-care (San Francisco Task Force on Compulsive Hoarding, 2009). As such, HD poses a significant public health burden.

Although only a few studies have been published to date, current evidence suggests that individuals with hoarding disorder may have poorer physical health and increased susceptibility to medical comorbidity (Ayers et al., 2010; Tolin et al., 2008; Nordsletten et al., 2013; Diefenbach et al., 2013; Ayers, Iqbal & Strickland, 2014; Ayers & Dozier, 2015). Commonly reported conditions include cardiovascular and arthritic conditions, diabetes or high blood sugar, lung problems, and sleep apnea. In an internet survey of self-identified hoarding participants and family informants, nearly two-thirds of individuals with HD reported at least one chronic and severe medical condition, compared to only half (of individuals without HD (Tolin et al., 2008). Additionally, participants with HD were more likely to report being overweight or obese than family members without HD, possibly exacerbating their risk for metabolic-related comorbidities. Other studies have found that older individuals with HD report higher rates of arthritic and lung conditions, diabetes, and

functional impairment than their non-psychiatric peers (Ayers et al., 2014). Moreover, a small investigation of geriatric patients with HD found that approximately 84% endorsed one or more co-occurring medical problems and, on average, reported approximately three medical comorbidities (Ayers & Dozier, 2015).

Estimates of the prevalence and types of medical problems associated with HD vary widely between studies, and previous studies have been limited by incomplete categorization of medical comorbidities and, for older adults with HD, relatively small sample sizes, warranting further investigation. In addition, studies investigating the health status of individuals with subclinical hoarding symptoms are lacking. Such investigation is necessary to better understand whether a dimensional relationship between hoarding behaviors and physical health exists.

The aim of this study was to evaluate the medical burden of adults with hoarding disorder and subclinical hoarding disorder using a large, online research registry sample of adult participants. We hypothesized that individuals with hoarding symptoms would have a greater medical burden than those without hoarding and that the medical burden would increase such that rates of medical comorbidities for those with subclinical hoarding symptoms would be intermediate between individuals without HD and those with HD. This investigation furthers our understanding of the relationship between hoarding symptoms and physical health and may aid in improving quality of life and longevity in individuals who suffer from hoarding disorder.

Methods

Participants and Assessments

Participants were members of the Brain Health Registry (BHR), a web-based research registry that aims to evaluate and longitudinally track medical and psychiatric health and increase participation in clinical trials (Weiner et al., 2018). Details describing BHR participants and thematic modules can be found elsewhere (Nutley et al., 2020). This analysis was conducted in 20,745 BHR participants who completed the *Hoarding and Clutter* and *Medical History* modules between February 2017 and December 2019. As BHR participants complete the online cognitive tests and questionnaires at multiple time points, a participant's most recent data from the Hoarding module was collected and used in the present analysis. At the time of *Hoarding and Clutter* module completion, the majority of participants (89.4%) simultaneously completed the *Medical History* module. Participants with hoarding data who did not simultaneously provide medical data were excluded from this analysis (n=2469). This investigation was reviewed and approved by appropriate ethical committees and informed consent according to the Declaration of Helsinki was obtained from all study participants.

Demographics

The socio-demographic variables analyzed in this study included age (18–90), gender (male/female), race (white/non-white), education (3 factor variable with levels less than college, college or graduate/professional), BMI (underweight or normal weight/overweight/obese),

current use of neuroleptic medications (including risperidone, paliperidone, olanzapine, quetiapine, aripiprazole; coded numerically as the total number of these medications used), and lifetime tobacco use (yes/no). A detailed overview of demographic characteristics and BMI calculation is included in the Supplement.

Hoarding Symptoms

The core assessment is an online adaptation of the Hoarding Rating Scale, Self-Report (HRS-SR), a 5-item measure of hoarding symptoms and severity (Tolin, Frost, & Steketee, 2010). This well-validated assessment evaluates the following hoarding symptoms: difficulty discarding, clutter, excessive acquisition, hoarding-related stress, and impairment to daily functioning. Individual items are scored using a 9-point Likert scale ranging from no difficulty (0) to extreme difficulty (8). Items are summed for a total score ranging from 0 to 40.

In order to better understand the medical burden associated with a range of hoarding symptoms, we classified total HRS-SR score into three categories: no HD, subclinical HD, and HD. Participants with a total score <10 were classified as no HD, based on the prior literature (Tolin et al., 2010). Participants with a total score greater than 14 were classified as HD. This cutoff score has been previously used in genetic, clinical, and epidemiological studies and has been shown to successfully differentiate individuals with HD from individuals with OCD *(sensitivity = 0.97, specificity = 0.97) [15]* and community controls (Cath et al., 2017; Iervolino et al., 2009; Monzani et al., 2014; Iervolino et al., 2011; Ivanov et al., 2013; Perroud et al., 2011; Frost, Steketee, & Tolin, 2011; Frost & Hristova, 2011). Participants with a total score between 10 and 14 were classified as subclinical HD. Validation analyses comparing self-reported hoarding symptoms, as measured by the HRS-SR, to clinical diagnoses of hoarding disorder as determined by clinical interview and best estimate/consensus diagnosis in a sub-sample of participants from this study (N=233), suggests that these cutoffs are conservative for this sample, and effectively identify individuals with clinically meaningful hoarding symptoms (Nutley et al., 2020).

Medical Conditions

Medical data were obtained from the BHR *Medical History* module, which assessed the lifetime history of stroke, heart disease, diabetes, high blood pressure, high cholesterol, asthma, arthritis, cancer, concussion, traumatic brain injury, hearing loss, or lung disease in a yes/no fashion. Participants were further asked about chronic pain, sleep apnea, and allergies using the following questions (yes/no): “Is chronic pain a problem for you,” “Have you ever been diagnosed with sleep apnea,” and “Do you have allergies?”

We subsequently classified the reported medical conditions into cardiovascular/metabolic ([CV/Met], stroke, heart disease, high blood pressure, high cholesterol, diabetes), autoimmune (asthma/lung disease, arthritis, allergies), acquired (cancer, concussion, traumatic brain injury, hearing loss), and other medical conditions (chronic pain, sleep apnea).

Psychiatric Burden

Participants were also asked to report lifetime history (yes/no) of anxiety disorders (including generalized anxiety disorder, panic disorder, specific or social phobia, and post-traumatic stress disorder); major depressive disorder; severe mental illness (including psychosis, schizophrenia, and bipolar disorder); psychiatric disorders of childhood (including autism, attention-deficit/hyperactivity disorder, Tourette and chronic or vocal tic disorder); obsessive compulsive or eating disorders; and substance use disorders (including alcohol abuse and drug abuse).

Statistical Analysis

We assessed normality and missing values for all relevant variables. We then used Pearson's chi-square and one-way analysis of variance (ANOVA) tests, as well as pairwise independent sample t-tests, to describe the population characteristics of individuals with HD and subclinical HD. We next compared the prevalence of self-reported medical conditions, stratified by HD classification, using the chi-square test for independence. For all Pearson's chi-square, ANOVA, and independent sample t-tests, Bonferroni adjustment for multiple testing was applied (three hoarding groups considered, α=0.016).

We assessed the relationship between HD status and medical comorbidity using separate multivariate logistic regression models adjusted for gender, age, race, education, BMI, use of psychiatric medication, lifetime tobacco use, and comorbid psychiatric conditions (logistic regression effective sample size: N=11,854 after excluding those with missing data). We next reduced the sample to only individuals who positively endorsed HD or subclinical HD and used separate multivariate logistic regression models to compare medical morbidity patterns between these groups (logistic regression effective sample size: N=1,644). For all regression models, Bonferroni adjustment for multiple testing was applied (12 medical conditions considered, α=0.004).

In a secondary analysis, we used chi-square tests and independent sample t-tests to assess the prevalence of hoarding behaviors of participants excluded from regression analyses due to missing data and found no significant differences from those included. Analyses were conducted using SAS version 9.4

Structural Equation Modeling

In the present analysis, we observed elevation of CV/Met morbidity among individuals with hoarding behaviors, as has been reported previously (Ayers et al., 2010; Tolin et al., 2008; Ayers et al., 2014; Ayers et al., 2015). We thus used Structural Equation Modeling (SEM) (MPlus, Version 8; Muthén & Muthén, 1998–2017) to examine the pathways from hoarding behavior, mental health, and lifestyle factors to CV/Met health conditions and to determine the direct association between hoarding behaviors and CV/Met vulnerability. The Supplement outlines the hypothesized model, as well as latent constructs, estimation, and model fit criteria for the SEM. After fitting the original model, numerous modifications were suggested by the program output to improve model fit. In order to ensure simplicity and maximize model interpretability, only modification indices that greatly decreased the model

chi-square were included in the final model (i.e. modification index value greater than 200; maximum modification index=394).

Results

Of the 20,745 BHR participants who completed the *Hoarding and Clutter* Module (mean age=60.6), 6.5% (n=1,348) met criteria for HD, 6.1% (n=1,268) met criteria for subclinical HD, and 87.4% (n=18,129) did not meet criteria for HD. In a comparison to BHR participants who did not complete the *Hoarding* module, a higher proportion of individuals included in this analysis were female, white, college educated, and of older age. Additionally, individuals included in this analysis were slightly less likely to be overweight or obese than BHR participants who did not complete the *Hoarding* module. A detailed comparison between the study sample and the total BHR population is outlined in Supplemental Table 1.

Compared to those without HD, a higher proportion of individuals with HD were female (81.6% vs. 74.4%), non-white (15.4% vs. 10.8%), and had not received a college degree (25.3% vs. 17.8%) (Table 1). Further, the percentage of individuals with HD who reported being obese was nearly double that of those without HD (40.4% vs. 20.5%); on average individuals with HD reported being approximately 17 pounds heavier than participants without HD (178 vs. 161 lbs.). Individuals with subclinical HD were more similar to those with HD than those without in terms of race, tobacco use, and age. Obesity rates for participants with subclinical HD (30.7%) were intermediate between those with (40.4%) and without (20.5%) HD.

With the exception of cancer and heart disease, individuals with HD reported significantly higher rates of all medical conditions compared than those without HD (Table 2); individuals with HD reported over twice the rates of diabetes (16.4% vs. 7.1%, $p<0.001$), chronic pain (48.9% vs. 26.2%, $p<0.001$), and sleep apnea (32.7% vs. 16.4%, $p<0.001$) than those without. After adjusting for gender, age, race, education, BMI, use of psychiatric medication, lifetime tobacco use, and psychiatric illness (e.g. anxiety disorders, depressive disorders, severe mental illness, psychiatric disorders of childhood, obsessive compulsive and eating disorders, and substance use disorders), the odds of CV/Met dysfunction, pain, and sleep related conditions remained significantly higher for those with HD than for those without (Figure 1; Supplemental Table 2). For nearly all medical conditions, individuals with subclinical HD had significantly-higher odds of most medical conditions compared to those without HD; and reported rates of diagnosis intermediate to those reported by individuals with HD and those without HD. However, differences in both adjusted and unadjusted comorbidity rates between HD and subclinical HD were significant only for chronic pain and sleep apnea (Supplemental Table 3).

Given that obesity has been associated with many of the medical outcomes of interest, we next added an interaction term between BMI and HD to the logistic regression model to assess the role of BMI as a moderator between hoarding behavior and medical morbidity. This interaction term was not significant, indicating that BMI does not serve as a moderator in this relationship. Similarly, the addition of covariates such as marriage, employment, and

retirement status did not significantly influence the model and were not included in the final analysis.

Paths to Cardiovascular and Metabolic Vulnerability

Finally, we used SEM to examine the direct and indirect relationships between hoarding symptoms and CV/Met vulnerability. We devised a path model with hoarding behaviors, demographic characteristics, mental health, and lifestyle factors as independent variables and CV/Met vulnerability as a dependent variable. Estimated direct and indirect standardized path coefficients for the final structural equation model (SEM) can be seen in Figure 2. Independent of demographic characteristics, lifestyle factors, and mental health, all hoarding symptoms were positively associated with increased cardiovascular/metabolic morbidity (β=0.22, SE=0.021, $p<0.0001$).

Modifications added to the final model include the union of the latent construct for demographic characteristics and the latent construct for lifestyle factors, a path from CV/Met vulnerability to obesity, and a path from mental health status to tobacco use. The final model demonstrated acceptable model fit [RMSEA=0.040 (0.039, 0.042); CFI=0.97; TLI=0.96].

Discussion

The results of this study confirm previous findings indicating that individuals with hoarding disorder have significantly higher rates of medical comorbidity than do individuals without hoarding behavior (Ayers et al., 2010; Tolin et al., 2008; Nordsletten et al., 2013; Diefenbach et al., 2013; Ayers et al., 2014; Ayers et al., 2015), and, as importantly, indicate that those with subclinical hoarding also experience substantially increased medical comorbidity.

Although we found elevated rates of most medical comorbidities in HD and subclinical HD, of particular interest are the findings that, after adjusting for demographic and behavioral characteristics and comorbid psychiatric conditions, the odds of cardiovascular/metabolic dysfunction, pain-, and sleep-related medical conditions were higher for individuals with HD compared to those without. Importantly, results of the SEM suggest that hoarding symptoms were directly associated with increased CV/Met morbidity, independent of weight, demographic and lifestyle factors, and psychiatric burden. Our findings confirm previous work suggesting substantial medical comorbidity among HD individuals compared to non-psychiatric peers (i.e. 90% vs. 44%; Ayers & Dozier, 2015), and in particular, reiterate concern regarding heightened prevalence of cardiovascular, metabolic, and sleep-related medical conditions that have been reported as highly prevalent among older individuals with HD (e.g. hypertension, high cholesterol, sleep apnea, diabetes, and heart disease; Ayers et al., 2014; Ayers & Dozier, 2015).

While the nature and directionality of the observed associations remains unclear, there are several potential explanations for our findings. First, it is possible that profound functional impairment and low levels of health care utilization contribute to the progression of medical comorbidity among individuals with HD. Previous studies suggest that hoarding behaviors are associated with limited activity involvement, an increased risk of falls, and difficulties

with self-care, all of which likely contribute to substantial functional impairment and reduced physical well-being (Vorstenbosch et al., 2012; San Francisco Task Force on Compulsive Hoarding, 2009). Additionally, older adults with HD show reduced rates of health care service utilization compared to those without, which may have a negative influence on the management of medical conditions and health outcomes (Ayers et al., 2014).

Second, it is possible that individuals with existing medical conditions experience increased impairment in daily self-care activities that lead to the build-up of clutter, artificially inflating measures of hoarding behavior (i.e. physical difficulties when removing clutter from the home). However, our data do not support this hypothesis. The majority of BHR participants reported minimal or mild clutter in the home, regardless of HD classification, suggesting that the clutter question may not be valid in this population. In addition, the determination of HD in the present study is based on multiple symptoms, rather than solely on the presence of clutter in the home, consistent with the DSM-5 criteria, and it is unlikely that individuals with pre-existing medical conditions would be misclassified as having HD or subclinical HD without endorsing other symptoms characteristic of hoarding disorder. Regardless, it is possible that medical conditions may worsen hoarding behavior and the underlying causes of hoarding behavior may be a risk factor for both HD and medical morbidity.

Previous work examining the association between metabolic conditions, pain, and psychiatric conditions including depression, attention deficit/hyperactivity disorder, and schizophrenia, suggests a probable bidirectional relationship influenced by a variety of biological, psychological, and social factors (Nousen, Franco, & Sullivan, 2013; Pereira et al., 2017; Bondesson et al., 2018; Pan et al., 2012). We have now expanded these findings to hoarding disorder, a psychiatric disorder that has a high prevalence in older adults, who also, independent of hoarding or other psychiatric illnesses, experience increased medical morbidity and mortality. Though hoarding behavior may occur as a secondary symptom of other medical or psychiatric conditions, the majority of hoarding symptoms in the general population are accounted for by HD, which, paradoxically, may also be comorbid with psychiatric conditions such as schizophrenia, OCD, and depression (Frost & Steketee, 2014; Pertusa, Gaston, & Choudry, 2019). Though schizophrenia, obsessive-compulsive and mood disorders are historically associated with elevated rates of medical morbidity, including conditions of the circulatory and endocrine systems (Momen et al., 2020; Aguglia et al., 2018), our findings indicate elevated medical morbidity among individuals with HD, after accounting for any co-occurring psychiatric conditions. However, additional work is needed to explore the temporality of the relationship between hoarding disorder and physical health, as well as underlying etiologies.

Limitations

To our knowledge, the present study is the largest investigation of the medical burden of hoarding behavior to date and the first to consider the influence of demographic, psychiatric, and lifestyle characteristics on the relationship between hoarding symptoms and medical conditions. While this study furthers our understanding of the medical burden associated

with hoarding behavior, there are limitations. First, all diagnoses used in this study were derived from self-report, introducing the potential for misclassification. Despite our use of well-validated measures of hoarding symptoms, we only have confirmed clinical diagnoses of HD or subclinical HD in a small subset of our participants. However, our findings indicate increased odds cardiovascular/metabolic dysfunction, pain-, and sleep-related medical conditions among those with clinical diagnoses of HD compared to those without HD (data not shown). Additionally, use of self-reported medical history may introduce recall bias. In this context, and given the dearth of literature assessing medical morbidity among individuals with hoarding behaviors, future epidemiological investigations will be necessary to validate estimates of the prevalence of these disorders among individuals with hoarding symptoms. Next, the BHR is not a nationally representative sample, but rather oversamples white females of older age living in US coastal regions (Nutley et al., 2020). Despite our efforts to investigate the role of demographic, psychiatric, and lifestyle factors on the relationship between hoarding behaviors and medical morbidity, additional factors, such as physical activity and lifetime history of a personality disorder, were not evaluated. Finally, as this is a cross-sectional study, we are unable to evaluate causality and temporality of the observed associations.

Conclusions

The medical burden of HD is higher than in the general population, and increases with increased severity, particularly in the case of cardiovascular/metabolic dysfunction, autoimmune, sleep and pain-related medical conditions. Psychiatric conditions including HD cause significant societal burden socially and economically, which is likely only increased by elevated medical morbidity (Tolin et al., 2008; Christensen et al., 2020). Accordingly, the assessment and management of medical comorbidity in individuals with HD and subclinical HD is likely a fundamental component in improving compliance with treatment, quality of life and longevity, and overall physical and psychiatric health outcomes. In addition, future study of the medical status of individuals with HD is essential. Such studies should include a longitudinal investigation of medical morbidity among individuals with HD and the influence of HD treatment programs on medical comorbidity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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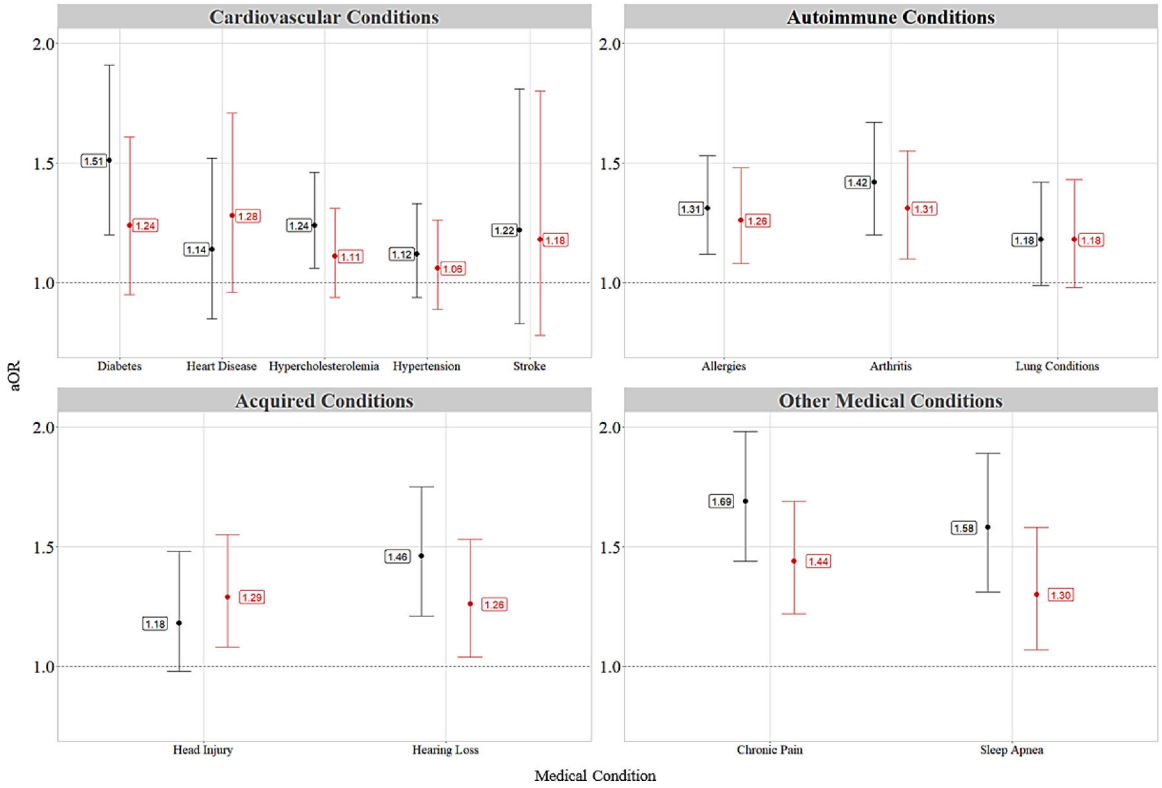

Figure 1:

Adjusted odds ratio (aOR) and 95% confidence interval (CI) for medical morbidity among individuals with HD (black) and subclinical HD (red) compared to those without HD. Adjusted for gender, age, race, education, BMI, psychiatric medication, history of smoking, and psychiatric burden

REF=No HD (dotted black line)

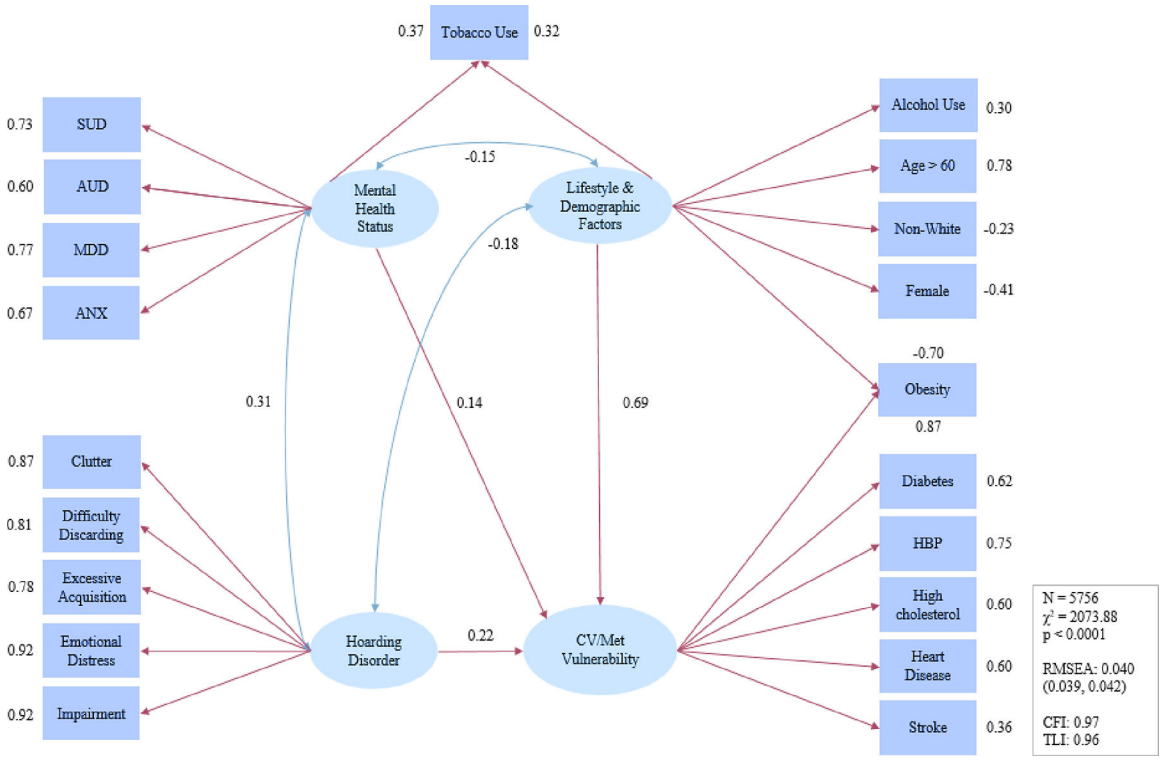

Figure 2:

Structural Equation Model (SEM) with significant standardized path coefficients for the effect of hoarding behavior on cardiovascular/metabolic vulnerability.

For all standardized beta values, $p<0.001$

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Table 1:

Sample characteristics, by HD status (HD measured using the HRS-SR: HD>14, subclinical HD: 10–14)

	Full Sample N=20,745 (%)	**HD n=1,348 (%)**	**Subclinical HD n=1,268 (%)**	**No HD n=18,129 (%)**	**p**
Gender					<0.0001
Male	5219 (25.2)	261 (19.4)	310 (24.5)	4648 (25.6)	
Female	15526 (75.8)	1087 (80.6)	958 (75.6)	13481 (74.4)	
Race					<0.0001
White	18369 (88.6)	1145 (84.9)	1078 (85.0)	16146 (89.1)	
Other	2376 (11.5)	203 (15.1)	190 (15.0)	1983 (10.9)	
Education					<0.0001
Less than College	3846 (18.5)	348 (25.8)	264 (20.8)	3234 (17.8)	
College	8300 (40.0)	564 (41.8)	540 (36.6)	7196 (39.7)	
Graduate/Professional	8599 (41.5)	436 (32.3)	464 (42.6)	7699 (42.5)	
Tobacco Use	7738 (37.3)	558 (41.4)	516 (40.7)	6664 (36.8)	0.0001
BMI[a]					<0.0001
Normal Weight[+]	5830 (47.4)	256 (31.5)	276 (35.5)	5298 (49.5)	
Overweight	3688 (30.0)	219 (27.0)	262 (33.7)	3207 (29.9)	
Obese	2781 (22.6)	337 (41.5)	239 (30.8)	2205 (20.6)	
Weight[b] (mean)	≈ 163	≈ 178	≈ 172	≈ 162	<0.0001
Age[c] (mean)	60.8	59.1	58.1	61.1	<0.0001
Psychiatric Medications[d] (mean)	0.02	0.06	0.03	0.02	<0.0001

[+]And underweight

Bonferroni adjusted chi-square confidence level = 0.015

[a]N=12,299

[b]N=12,905

[c]N=19,827

$d_{N=14,026}$

Table 2:

Unadjusted prevalence of medical conditions, by HD status

	HD n=1,348 (%)	Subclinical HD n=1,268 (%)	No HD n=18,129 (%)	P-value*
Cardiovascular				
Stroke	50 (3.7)	45 (3.9)	492 (2.7)	0.0086
Heart Disease	125 (9.3)	100 (7.9)	1377 (7.6)	0.0819
Diabetes	213 (15.8)	163 (10.7)	1299 (7.2)	<0.0001
Hypertension	556 (41.3)	479 (37.8)	5850 (32.3)	<0.0001
High Cholesterol	653 (48.4)	542 (42.7)	7139 (39.4)	<0.0001
Autoimmune				
Asthma/Lung Disease	329 (24.4)	294 (23.2)	3112 (17.2)	<0.0001
Arthritis	713 (52.9)	565 (44.6)	7021 (38.7)	<0.0001
Allergies	858 (63.7)	774 (61.0)	9662 (23.3)	<0.0001
Acquired				
Cancer	207 (15.4)	192 (15.1)	3042 (16.8)	0.1439
Concussion/TBI	351 (26.0)	308 (24.3)	3151 (17.4)	<0.0001
Hearing Loss	392 (29.1)	331 (26.1)	4275 (23.6)	<0.0001
Other Medical Conditions				
Chronic Pain	657 (48.7)	476 (37.8)	4785 (26.4)	<0.0001
Sleep Apnea	431 (32.0)	307 (24.2)	2951 (16.3)	<0.0001

*Bonferroni adjusted confidence level: p<0.015

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