The Relationship between body mass index and musculoskeletal diagnosis in Veterans

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Objectives

- Comorbid overweight/obesity and chronic pain
- Painful conditions among Veterans with overweight/obesity
- The relationship among BMI, pain intensity, and musculoskeletal diagnoses
  - Aims
  - Methods
  - Results
  - Implications and future directions
- Clinical considerations

The relationship between overweight/obesity and chronic pain

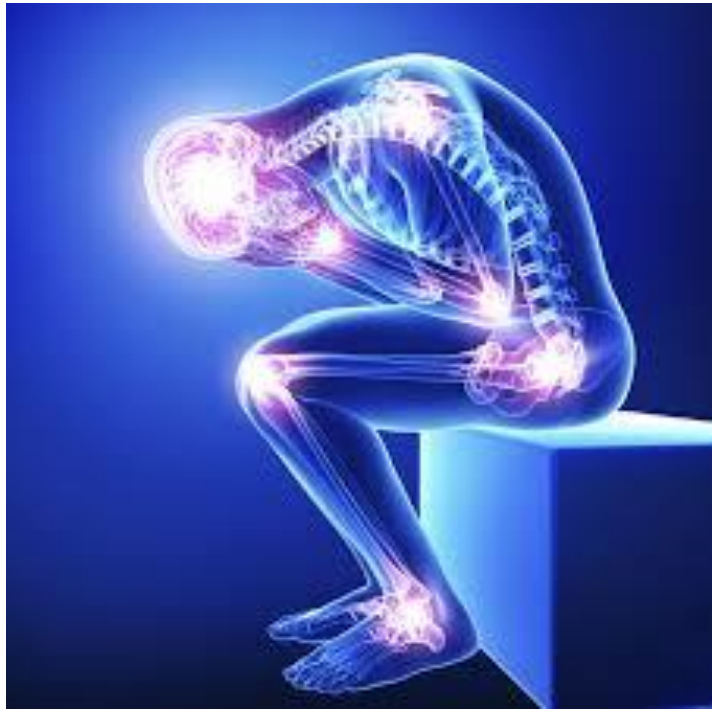
- Pain and obesity are two of the most prevalent chronic diseases in the US and are especially common among Veterans in VHA care[1]

- Estimated prevalence of overweight/obesity:
  - 68.0% general U.S. population[1]
  - 76.9% Veterans in VHA care[2]

- Estimated prevalence of chronic pain:
  - Approximately 100 million Americans experience chronic pain[3]
  - Prevalence among Veterans appears to be comparable or higher[4]

- Rates of comorbid pain and overweight/obesity: 20-45% of overweight/obese individuals reporting pain (non-Veterans)[5]

The relationship between overweight/obesity and chronic pain



- Higher BMI associated with increased risk of recent pain[6] and report of a painful condition within the previous year[5]
- Obesity has been shown to predict the onset and progression of pain[7]
- Obese patients have reported engaging in poor eating habits and avoiding physical activity in response to pain[8]

Painful conditions among Veterans with overweight/obesity

- Given the high prevalence of pain and overweight/obesity and evidence suggesting that each may serve as a barrier to treatment of the other, it is important to better understand the clinical correlates of veterans with comorbid pain and overweight/obesity

- Aim
  - Examine prevalence and correlates of self-reported painful conditions (i.e., joint pain, back pain) among overweight/obese veterans expressing interest in weight management treatment

Higgins DM, Buta E, Dorflinger L, Masheb RM, Ruser CB, Goulet JL, Heapy AA. Prevalence and correlates of painful conditions and multi-morbidity in a national sample of overweight/obese veterans; *JRRD,* 2016;53(1):71-82.

Painful conditions among Veterans with overweight/obesity: Methods

- Large national sample of Veterans interested in weight loss treatment (N= 45,477) who responded to the MOVE!23 survey in 2006

- Self-reported weight/height consistent with BMI ≥25
- Variables assessed: Demographics (age, gender, race/ethnicity), Comorbidities (e.g., diabetes, HTN, CAD, hyperlipidemia, depression, anxiety, PTSD, total # of comorbidities), BMI category (overweight, obesity class I, II, III)

- Pain Groups
  - No pain (i.e., neither back pain nor arthritis/joint pain)
  - Back pain only
  - Arthritis/joint pain only
  - Combined back and arthritis/joint pain (i.e., those respondents who endorsed *both* pain problems)

- Analyses:
  - Descriptive statistics, multivariable multinomial logistic regression model of pain group as a function of variables listed above

Painful conditions among Veterans with overweight/obesity: Results

- High proportion of the sample (72%) of overweight/obese Veterans reported one or more painful conditions
  - 10% reporting back pain only
  - 26% reporting arthritis pain only
  - 35% reporting combined back and arthritis pain.
- Mean # comorbidities 3.0 (SD = 2.0) and was lower in the “no pain” group; “both back pain and arthritis” group most likely to report 5+ comorbidities (32%)
- Among those with combined back pain and arthritis, the proportion with any given comorbid condition is quite high (e.g., 67% HTN, 38% diabetes, 53% hyperlipidemia, 20% lung disease, 50% depression, 41% anxiety) and those patients were most likely to report five+ comorbidities (32%)
- Model showed those with higher BMIs or higher total # comorbidities were more likely to report painful conditions

Painful conditions among Veterans with overweight/obesity: Conclusions and Limitat

- Pain interferes with the self-management of other conditions/is associated with poorer outcomes (e.g., diabetes, PTSD)
  - Helpful to potentially address pain in weight management programs

- Veterans who are interested in MOVE! have an extremely high burden of comorbidity, particularly those with more than one painful condition
  - Possible explanation for the low mean weight loss seen in the MOVE! program

  - MOVE! was designed on a population health approach and was developed to be a low barrier to entry program that would attract many Veterans

    - The patients who attend have multimorbidities, including extremely high rates of painful conditions, that likely complicate care and interfere with their weight loss efforts

- Limitations
  - The MOVE!23 was the sole source of data and all data are self-reported (i.e., height, weight, and comorbidities)
  - The MOVE!23 question from which data for painful conditions and comorbidities for the current study were derived does not specifically ask about “diagnosed” conditions

The relationship among BMI, pain intensity, and Musculoskeletal Diagnoses

- To date, the relationship between BMI and pain among veterans with specific pain-related conditions has not been investigated

- Objective:
  - Examine BMI distribution among musculoskeletal disorders (MSD) as well as to develop a descriptive comparison of demographic information and clinical characteristics
- Aims
  1. To examine which MSDs are associated with the highest BMI
  2. Among Veterans with MSD, are BMI and pain intensity associated at initial MSD diagnosis?
  3. Does the association between BMI and pain intensity vary by specific MSD?

Methods

- MSD Cohort was created to characterize variation in pain, comorbidities, treatment, outcomes among patients with MSD receiving VHA care
  - Cohort inclusion criteria were two or more outpatient visits occurring within 18 months of one another or one inpatient visit with an MSD diagnosis in 2000-2011 (N= 5,237,763). Patients entered the cohort on the day of their first MSD diagnosis.

- Variables:
  - BMI category (underweight <18.5; normal 18.6-24.9; overweight 25-29.9; obesity Class I 30-34.9; Class II 35-39.9; Class III 40+)
  - MSD group :
    - non-traumatic joint pain
    - low back pain [LBP]
    - back pain
    - neck pain
    - osteoarthritis [OA]
  - Demographics (race/ethnicity, age, marital status, gender)
  - Physical and mental health conditions
  - Pain intensity ratings (Numeric Rating Scale [NRS]; (0 to 10 scale, 0=no pain, 10=worst imaginable pain)

Methods (continued)

- BMI calculated using height and weight at entry into the cohort (+/- 3 months)
- Pain intensity NRS calculated at entry into the cohort
- ICD-9 diagnoses: 2 or more codes for outpatient and/or 1 or more codes for inpatient visits within a period of 18 months
- N= 1,774,128 (with only one MSD)

Analyses

- Outcome: presence of moderate/severe pain (NRS>=4)
- Primary predictor: BMI category (underweight, normal, overweight, obese class I,II, and III)
- Logistic regression used to model the relationship between presence of moderate/severe pain (pain intensity Numeric Rating Scale >=4) and BMI category, controlling for demographic and clinical confounders (e.g., MSD group, hypertension, CAD, Stroke, Hepatitis C, Diabetes, COPD, Depression, Anxiety, PTSD, Alcohol Abuse, Drug Abuse)
- To see whether the association between BMI and pain varies by MSD group, we fit an additional model including the interaction of BMI with MSD.

Results: Descriptives

- Mean+/-SD Age 59+/-16
- Mean BMI 29 +/- 6
- 95% male; 77% white
- The proportion reporting moderate to severe pain (NRS>=4) ranged from 40% in overweight to 50% in underweight and obesity class III
- The proportion reporting moderate to severe pain (NRS>=4) ranged from 29% in OA group to 53% in LBP and back pain groups

Descriptive Statistics by MSD group (% or mean+/- SD)

	Back pain	LBP	Neck pain	Non-Traumatic JD	OA	Combined
	(N=136369)	(N=432192)	(N=85513)	(N=628771)	(N=491283)	(N=1774128)
Age	56.21+/-16.49	55.96+/-15.87	57.31+/-14.59	56.95+/-16.09	66.85+/-12.75	59.41+/-15.83
Male	93%	94%	93%	93%	97%	95%
White	77%	75%	77%	74%	84%	77%
Black	15%	16%	15%	18%	11%	15%
Hispanic	6%	6%	5%	6%	3%	5%
Other	3%	3%	3%	3%	2%	2%
Married	53%	54%	52%	54%	64%	57%
Not Married	47%	46%	48%	46%	36%	43%
Hypertension	46%	46%	47%	47%	59%	50%
CAD	15%	14%	14%	14%	21%	16%
Stroke	0%	0%	1%	1%	0%	1%
Hepatitis C	4%	3%	3%	3%	2%	3%
Diabetes	17%	17%	16%	18%	22%	19%
COPD	9%	8%	9%	7%	10%	8%
Depression	21%	20%	20%	16%	12%	16%
Anxiety	8%	8%	9%	7%	5%	7%
PTSD	10%	10%	10%	9%	5%	8%
Alcohol Abuse	9%	8%	9%	8%	4%	7%
Drug Abuse	5%	4%	4%	4%	2%	4%
BMI	28.77+/- 5.61	29.08+/- 5.55	28.15+/- 5.13	29.31+/- 5.64	29.62+/- 5.69	29.24+/- 5.62
BMI category : underweight	1%	1%	1%	1%	1%	1%
Normal	24%	22%	26%	21%	19%	21%
Overweight	39%	40%	42%	39%	40%	39%
Obese class I	24%	25%	22%	25%	26%	25%
Obese class II	9%	9%	7%	10%	10%	9%
Obese class III	4%	4%	2%	4%	5%	4%
Pain NRS	3.85+/-3.36	3.83+/-3.34	3.51+/-3.27	3.22+/-3.21	2.09+/-2.89	3.12+/-3.25
pain category : 0	33%	33%	36%	39%	57%	42%
1--3	15%	15%	16%	17%	14%	15%
4--6	25%	26%	25%	24%	17%	23%
7--10	27%	27%	23%	20%	12%	20%

Results: Aim 1 (To examine which MSDs are associated with the highest average BMI)

- After adjusting for other patient characteristics, we estimated that the average BMI in those with OA was 0.59 points higher than in those with non-traumatic joint disorder (reference group), and higher than all the other MSD groups.

- From the same linear regression model, we obtained the LS-mean BMI (mean BMI adjusted for socio-demographics and comorbidities) for every MSD group.
  - OA is the group with the highest BMI
  - All pairwise comparisons between MSD groups were statistically significant, even after Bonferroni adjustment for multiple comparisons ($p<0.0001$).

Table 1. Association between MSD group and BMI, after adjusting for other patient characteristics

Predictor	Estimate	95% Confidence Limits		p-value
Non Traumatic Joint (ref)				
Back Pain	-0.47	-0.50	-0.43	<.0001
LBP	-0.26	-0.28	-0.24	<.0001
Neck Pain	-1.17	-1.20	-1.13	<.0001
OA	0.59	0.57	0.61	<.0001

Table 2. Adjusted mean BMI by MSD group (from regression model in Table 1). MSD groups are ordered from lowest to highest BMI

MSD group	LSMEAN BMI (mean BMI adjusted for other variables in the model)	95% Confidence Limits	
Neck Pain	28.07	28.04	28.11
Back Pain	28.77	28.74	28.80
LBP	28.97	28.96	28.99
Non Traumatic Joint	29.24	29.22	29.25
OA	29.83	29.81	29.84

Results: Aim 2 (Among Veterans with MSD, are BMI and pain intensity associated at initial MSD diagnosis?)

- We found a U-shaped association between BMI and pain.
- Compared to *normal weight* patients, underweight patients (OR=1.24, 95% CI 1.20-1.28) and obesity class II (OR=1.06, 95% 1.05-1.08) and III (OR=1.23, 95% 1.21-1.25) patients had higher odds of reporting moderate/severe pain.
- Overweight (OR=.92, 95% .91-.93) and obesity class I (OR=.97, 95% .96-.98) patients had slightly lower odds of reporting moderate/severe pain.

Adjusted OR of moderate/severe pain (results from multivariable logistic regression model predicting presence of moderate/severe pain)

	OR	95%CI	p-value
BMI category			
Normal (ref)			
Underweight	1.24	(1.20, 1.28)	<.0001
Overweight	0.92	(0.91, 0.93)	<.0001
Obese class I	0.97	(0.96, 0.98)	<.0001
Obese class II	1.06	(1.05, 1.08)	<.0001
Obese class III	1.23	(1.21, 1.25)	<.0001
MSD group			
Non-traumatic JD (ref)			
back pain	1.41	(1.39, 1.43)	<.0001
LBP	1.39	(1.38, 1.41)	<.0001
neck pain	1.19	(1.17, 1.20)	<.0001
OA	0.64	(0.64, 0.65)	<.0001
Age			
age – 60	0.98	(0.98, 0.98)	<.0001
(age - 60)^2	1.00	(1.00, 1.00)	<.0001
Male	1.03	(1.02, 1.04)	<.0001
Not Married	1.20	(1.19, 1.21)	<.0001
Race			
White (ref)			
Black	1.42	(1.41, 1.43)	<.0001
Hispanic	0.99	(0.97, 1.00)	0.10
Other	1.20	(1.18, 1.23)	<.0001
Comorbidity			
HTN	0.98	(0.97, 0.99)	<.0001
CAD	0.96	(0.95, 0.97)	<.0001
Stroke	1.01	(0.97, 1.06)	0.63
HCV	1.38	(1.36, 1.41)	<.0001
Diabetes	1.12	(1.11, 1.13)	<.0001
COPD	1.16	(1.15, 1.17)	<.0001
Depression	1.28	(1.27, 1.29)	<.0001
Anxiety	1.05	(1.04, 1.07)	<.0001
PTSD	1.24	(1.23, 1.26)	<.0001
Alcohol Abuse	1.02	(1.00, 1.03)	0.01
Drug Abuse	1.08	(1.06, 1.11)	<.0001

Results: Aim 3 (Does the association between BMI and pain intensity vary by specific MSD?)

- Evidence of the pain-BMI association varying by MSD group (p for interaction<.0001)
- The strength of the association between obesity class III (vs. normal weight) and moderate/severe pain varied across MSD groups from OR=1.09 (95% CI 1.05-1.12) for LBP to OR=1.37 (95% CI 1.33-1.41) for OA (i.e., more pronounced effect of obesity class III in OA)

Adjusted OR of moderate/severe pain by MSD group (from logistic model including BMI*MSD group interaction)

	OR	95%CI	p-value
Non-traumatic JD			
Normal (ref)			
Underweight	1.22	(1.16, 1.30)	<.0001
Overweight	0.92	(0.91, 0.93)	<.0001
Obese class I	0.97	(0.95, 0.98)	<.0001
Obese class II	1.06	(1.04, 1.08)	<.0001
Obese class III	1.25	(1.22, 1.28)	<.0001
Back pain			
Normal (ref)			
Underweight	1.24	(1.12, 1.38)	<.0001
Overweight	0.90	(0.88, 0.93)	<.0001
Obese class I	0.95	(0.92, 0.98)	0.001
Obese class II	1.02	(0.97, 1.06)	0.45
Obese class III	1.10	(1.03, 1.17)	0.002
LBP			
Normal (ref)			
Underweight	1.28	(1.19, 1.37)	<.0001
Overweight	0.92	(0.91, 0.94)	<.0001
Obese class I	0.95	(0.94, 0.97)	<.0001
Obese class II	1.03	(1.00, 1.05)	0.04
Obese class III	1.09	(1.05, 1.12)	<.0001
Neck pain			
Normal (ref)			
Underweight	1.10	(0.96, 1.25)	0.157
Overweight	0.94	(0.91, 0.97)	0.001
Obese class I	0.98	(0.94, 1.02)	0.394
Obese class II	1.03	(0.97, 1.10)	0.270
Obese class III	1.12	(1.03, 1.23)	0.012
OA			
Normal (ref)			
Underweight	1.26	(1.17, 1.36)	<.0001
Overweight	0.93	(0.92, 0.95)	<.0001
Obese class I	1.02	(1.00, 1.04)	0.053
Obese class II	1.13	(1.11, 1.16)	<.0001
Obese class III	1.37	(1.33, 1.41)	<.0001

Conclusions/Implications

- Patients with OA had the highest BMI
- Among those with MSDs, underweight patients and obesity class II and III patients had higher odds of reporting moderate/severe pain.
- Higher BMI is associated with increased pain intensity (compared to normal weight Veterans)
  - Those with severe obesity and OA had the highest odds of reporting moderate to severe pain intensity
- Overall, there is high comorbidity between overweight/obesity and painful conditions
  - Likely affects pain self-management efforts
  - Likely affects weight loss outcomes
- Need for programs that address both weight and pain management to optimize outcomes for these patients (especially those with OA)

Future directions

- Additional analyses to explore:

  1. Does number of MSD diagnoses matter? Specifically, what's the relationship between BMI and pain intensity if you have 1, 2, 3, 4, or more MSDs?

  2. Among people with 5 consecutive years of data, how does pain intensity and BMI co-vary for the whole sample or subgroups? Does this relationship change over time?

Clinical Considerations

- The two studies presented support a need for a combined approach to managing weight and chronic pain

- VHA has two programs to address these high prevalence problems separately:
  - MOVE
  - CBT-CP

- Barriers to engagement in existing treatments
  - Patient concerns
  - MOVE is a population-based approach to weight management
  - CBT-CP requires specialized training and is currently limited in availability (although this is improving with the OMH EBP rollout program for CBT-CP)

Clinical Considerations: Using practice to inform science

- Clinical need for an integrated program
- Pending RR&D SPiRE award
  - Develop an integrated intervention (i.e., “MOVE!/PSM”) that will include components of MOVE! and CBT-CP along with a motivational enhancement component to increase physical activity (i.e., important for both pain and weight management) intervention
  - Potentially providing Veterans with a single, integrated treatment for these high prevalence, high impact comorbid conditions. It will be developed to be delivered by clinicians with varied professional training.
- Advantages:
    - Leverages components of existing VHA behavioral programs (e.g., MOVE!, CBT-CP)
    - Targets the burden of comorbid overweight/obesity and chronic pain which contributes to poor outcomes wherein weight loss attempts are stymied by pain. Reciprocally, pain interferes with physical activity and contributes to further weight gain.
- The primary purpose of the proposed project is to develop an evidence-based intervention to reduce weight and pain-related disability in Veterans.

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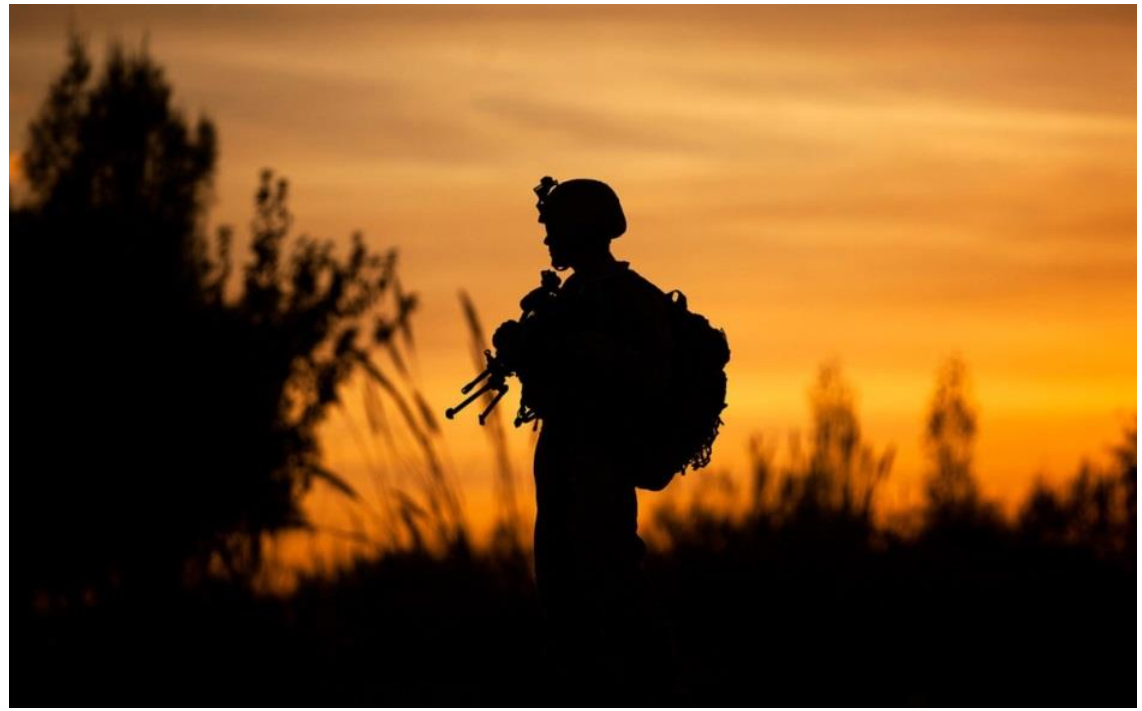

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