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Weight management treatment modalities in patients with overweight or obesity: A retrospective cohort study of administrative claims data

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ABSTRACT

Background: The purpose of this study was to describe demographic and clinical characteristics among patients who have medical encounters for weight management treatments and to investigate the association of those characteristics with treatment modality.

Methods: This was a retrospective database study using medical claims, pharmacy claims, and enrollment information from commercial and Medicare Advantage with Part D members in the Optum Research Database from 01/01/2011−2/29/2020. Adult patients with a claim for a weight management treatment from 01/01/2012−2/28/2019 were categorized into cohorts according to the highest intensity intervention received. To examine the association between patient characteristics and treatment modality received, a multinomial logit model was performed.

Results: Cohorts by increasing intensity included lifestyle intervention (LSI, n = 67,679), weight reduction pharmacotherapy (WRRx) with an anti-obesity medication (AOM, n = 6,905), weight reduction procedure (WRP, n = 1,172), and weight reduction surgery (WRS, n = 18,036). Approximately 32.1% and 16.6% of patients who received WRS or WRP had an LSI during the 12-month baseline, and only 0.6% and 0.4% had treatment with long-term AOMs. In a multinomial logit model, patients with type 2 diabetes (not including WRRx cohort), respiratory disorders, cardiovascular risk factors, pain disorders, and mental health conditions had increased odds of treatment with higher intensity intervention versus LSI. Patients who were male, received an intervention more recently (2016-2019), or had a Charlson comorbidity score of 1 (compared to 0) had decreased odds of treatment with higher intensity interventions.

Conclusion: In this study, age, sex, body mass index, obesity-related complications, and Charlson comorbidity score appeared to influence the type of weight management treatment modality received. This study improves understanding of weight management treatment utilization and identifies gaps and opportunities to improve obesity care with the appropriate use of different treatment modalities.

1. Introduction

Over 73% of American adults ≥ 20 years of age are living with overweight or obesity with rates expected to rise [1,2]. Overweight and obesity and their resulting health complications cost an estimated $260.6 billion annually in direct medical costs in the United States [3].

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Depending upon the severity and cause of the excess weight, there are several evidence-based weight management treatment modalities available that have proven weight reduction and prevention and regression of obesity-related complications (ORCs).

Comprehensive lifestyle intervention (LSI) programs are the first-line therapy option that provides patient education to incorporate modifications in nutrition, physical activity, and behavior for weight management [4,5]. Despite regaining almost all weight lost in the Diabetes Prevention Program 10 years following the end of the intervention, participants assigned to LSI alone compared to placebo retained a significant reduction (34%, 95% CI = 24%–42%) in the risk of type 2 diabetes mellitus (T2DM) [6]. Clinical guidelines recommend approved anti-obesity medications (AOMs) as an adjunct to LSI for patients with a body mass index (BMI) $\geq$ 30 kg/m^2 or $\geq$ 27 kg/m^2 with an ORC in whom an LSI alone was unsuccessful [4,5,7,8]. Clinically meaningful weight reduction is considered a 5% decrease in initial weight; however, patients with ORCs may require additional weight reduction to experience clinical benefits [4,5,7,8]. Most approved AOMs target aspects of underlying neurohormonal dysregulations that contribute to impaired energy balance, with five AOMs currently FDA-approved for long-term use. These include orlistat (approved in 1999), phentermine-topiramate (approved in 2012), bupropion-naltrexone (approved in 2014), liraglutide (approved in 2014), and semaglutide (approved in 2021). Lorcaserin was approved by the FDA in 2012, but was removed from the US market in 2020 due to concerns of a small increase in risk of malignancy [9]. These AOMs provide long-term treatment options that have demonstrated average placebo-subtracted weight reductions of approximately 4%–12% of initial body weight in clinical trials [10–17]. All trials demonstrated variability in weight change, such that some participants did not achieve the minimum 5% weight reduction, while others lost significantly more. Treatment with 2.4 mg semaglutide resulted in 86.4% of participants experiencing $\geq$ 5% weight reduction and 50.5% experiencing $\geq$ 15% weight reduction, with significant improvements in blood pressure, lipids, C-reactive protein, HbA1c, and physical functioning scores compared to placebo [17]. Patients with a BMI $\geq$ 40 kg/m^2 or $\geq$ 35 kg/m^2 with at least one ORC who have been unable to achieve clinically meaningful weight reduction with less invasive methods may be eligible for a weight reduction procedure (WRP; eg, gastric balloon, gastric banding, intermittent vagal blockade/gastric electrical stimulation) or weight reduction surgery (WRS; eg, gastric bypass, sleeve gastrectomy, duodenal switch) [8].

Despite the availability of effective treatment options, fewer than 2% and 1% of eligible patients have been prescribed AOMs [18–20] or a WRS/WRP, respectively [21]. In one study, 72% and 61% of providers said they were comfortable providing exercise and dietary counseling, respectively, but only 16% and 36% were comfortable recommending medical and surgical options to their patients, respectively [22]. When primary care providers were asked what would make them discuss obesity with their patients, 57% indicated they would wait for the patient to broach the subject and 68% indicated an obesity-related risk factor would prompt discussion [23]. Additionally, 31% of health care providers indicated they would never prescribe an AOM [24]. While 89% of providers would refer patients for bariatric surgery (assuming no contraindications), almost half would only refer at BMI thresholds greater than those recommended in the guidelines [24]. Similarly, only 8% of providers were aware of the guideline-recommended thresholds to initiate and continue AOMs, with one in five believing use of AOMs was unsafe [25].

While studies have documented provider characteristics and weight management treatment prescribing patterns, it is less clear how patient characteristics are associated with which weight management treatment modality a patient receives. The purpose of this study was to describe demographic and clinical characteristics among patients who have medical encounters for weight management treatments and to investigate the association of those characteristics with treatment modality.

2. Methods

2.1. Data source

This study was a retrospective database study using medical claims, pharmacy claims, and enrollment information from commercial and Medicare Advantage with Part D members in the Optum Research Database from January 01, 2011 through February 29, 2020 (study period). Obesity and other diagnoses were identified using International Classification of Diseases, 9th and 10th Revisions, Clinical Modification (ICD-9-CM/ICD-10-CM) diagnosis codes. Relevant procedures were identified using ICD-9/ICD-10 procedure codes (ICD-9-CM/ICD-10-PCS), Current Procedural Terminology codes, and Healthcare Common Procedure Coding System codes, in combination with place of service, provider specialty, and revenue codes. Anti-obesity medications were identified through National Drug Code numbers. Institutional Review Board approval or waiver of authorization was not required for this study as no identifiable protected health information was accessed.

2.2. Patient sample selection

To be eligible for study inclusion, patients must have had $\geq$ 1 claim for a weight management treatment (in order of lowest to highest intensity: LSI, weight reduction pharmacotherapy with an AOM [WRRx], WRP, or WRS, Supplementary Table 1) from January 01, 2012 through February 28, 2019 (identification period). The date of the first claim for the intervention was the index date. Among patients with multiple intervention types during the identification period, the index date was the date of the first claim for the highest intensity intervention. Patients were also required to be $\geq$ 18 years of age as of the index year with continuous health plan enrollment with medical and pharmacy benefits for 12 months prior to (baseline period) and 12−36 months (variable length) including and following the index date (follow-up period). Patients were excluded if they had evidence of pregnancy, labor, or delivery during the baseline period or if they had unknown sex, geographic region, or health plan type.

2.3. Study cohorts

Patients were stratified into 4 mutually exclusive weight management treatment cohorts based on the highest intensity intervention received during the identification period. Patients in the LSI cohort had $\geq$ 1 claim for a weight reduction-related LSI with a primary diagnosis code for overweight or obesity on the same claim during the identification period. Patients in the WRRx cohort had $\geq$ 1 claim for a AOM (liraglutide, lorcaserin, naltrexone/bupropion, orlistat, phentermine/topiramate) during the identification period. Patients in the WRP and WRS cohorts had $\geq$ 1 claim for a WRP or WRS, respectively, with a primary diagnosis code for overweight or obesity during the identification period. Patients were excluded from each intervention group if they had evidence of the same or a higher intensity intervention during the baseline period. Patients in the WRRx cohort were also excluded if they had evidence of multiple AOMs on the index date or ST-AOMs (benzphetamine, diethylpropion, phendimetrazine tartrate, phentermine) during the baseline period.

2.4. Study measures

2.4.1. Patient demographics and baseline clinical characteristics

Demographic characteristics measured as of the index date included age (as of the index year), sex, health plan type, geographic region, and index year (ie, 2012–2015 versus 2016–2019; dates chosen based on ICD-9 to ICD-10 switch). The Charlson comorbidity score (a measure of mortality risk) [26–28] and BMI category (highest value identified via ICD-9/ICD-10 diagnosis codes in the claims) were measured over the 12-month baseline period.

Comorbid conditions were presented in the following groups:

cardiovascular risk factors (dyslipidemia and hypertension), respiratory disorders (asthma and sleep apnea), pain disorders (osteoarthritis and back pain), mental health conditions (anxiety and depression), T2DM, non-alcoholic fatty liver disease/non-alcoholic steatohepatitis or chronic kidney disease, atherosclerotic cardiovascular disease (ASCVD) and related conditions (cerebrovascular disease, ischemic heart disease, and peripheral arterial disease), reproductive conditions (hypogonadism, polycystic ovarian syndrome, and female infertility), other cardiac disorders (atrial fibrillation/flutter and heart failure), autoimmune/inflammatory arthritis (rheumatoid arthritis, ankylosing spondylitis, enteropathic arthropathy, and psoriatic arthritis), and dementia (including Alzheimer's disease).

2.4.2. Baseline utilization of weight management treatment

Patients' baseline utilization of weight management treatment(s) was captured for each eligible treatment modality (ie, treatments of lower intensity relative to the index intervention) and reported as a percentage.

2.4.3. Baseline all-cause healthcare resource utilization

Utilization of all-cause healthcare resources was captured for each patient and reported as both the percentage of patients with ≥ 1 ambulatory (physician office or hospital outpatient) visit, emergency room visit, and inpatient stay and the counts of those visits/stays presented monthly during the baseline period.

2.5. Analysis

2.5.1. Descriptive analyses

Numbers and percentages were provided for dichotomous and categorical variables and means and standard deviations were provided for continuous variables. Results were descriptive in nature and no statistical testing was performed to compare across months or between cohorts.

2.5.2. Multivariable analyses

To examine the association between patient characteristics and treatment modality received, a multinomial logit model was performed. The model included age category, sex, geographic region, health plan type, and index year group as of the index date, as well as baseline Charlson comorbidity score, hospitalization or emergency visits, and ORCs. If the bivariate association between a comorbid condition and treatment modality received was statistically significant ($p < 0.05$), the comorbid condition was retained in the full model.

3. Results

3.1. Baseline patient demographics and clinical characteristics

A total of 93,792 patients were included in the study sample, of which, 18,036 were included in the WRS cohort, 1,172 were included in the WRP cohort, 6,905 were included in the WRRx cohort, and 67,679 were included in the LSI cohort (Table 1). Across the treatment modality cohorts, patients were predominantly female (range 60.7%–77.4%) and commercially insured (range 76.8%–90.6%), with approximately half between the ages of 40–59 years (range 45.9%–59.9%) (Table 2). Mean Charlson comorbidity scores ranged from 0.5 to 1.1 across the treatment modalities. Fig. 1 shows the top ORCs across the treatment modality cohorts with the most common being cardiovascular risk factors (range 59.8%–79.8%).

3.2. Baseline utilization of weight management treatment

A total of 32.1% of patients in the WRS cohort, 16.6% of patients in the WRP cohort, and 3.6% of patients in the WRRx cohort had evidence of an LSI during the baseline period (Table 3). Among patients in the WRS cohort, 0.6% had a fill for an AOM (0.01 mean fills) and 1.1% had a fill for an ST-AOM (0.03 mean fills) during the baseline period. Even fewer patients in the WRP cohort had a fill for an AOM (0.4%, 0.01 mean fills) or an ST-AOM (0.8%, 0.02 mean fills) during the baseline period.

Table 1
Patient sample selection.

Criteria	WRS	WRP	WRRx	LSI
≥1 claim for the index treatment from 01/01/2012–02/28/2019 (ie, LSI, AOM, WRP, WRS)	34,159	2,455	16,022	172,790
Aged ≥ 18 years old as of index date	34,109	2,432	16,007	153,297
Continuous enrollment in the health plan with medical and pharmacy coverage during the 12-month baseline period and 12−36-month follow-up period	18,386	1,233	8,114	69,771
No record or claim for or an equal or increased intensity weight management intervention during the baseline period	18,372	1,201	7,081	69,113
No evidence of pregnancy, labor, or delivery during the baseline period	18,039	1,179	6,923	67,712
Known sex, geographic region, health plan, and intervention type	18,036	1,172	6,920	67,679
Single AOM on index date and no evidence of ST-AOM use on index date	n/a	n/a	6,905	n/a
Final study sample	**18,036**	**1,172**	**6,905**	**67,679**

AOM; anti-obesity medication; LSI, lifestyle intervention; ST-AOM, short-term anti-obesity medication; WRP, weight reduction procedure; WRRx, weight reduction pharmacotherapy; WRS, weight reduction surgery.

3.3. Baseline all-cause healthcare resource utilization

Baseline healthcare resource utilization is shown in Fig. 2. Among patients in the WRS and WRP cohorts, the number of ambulatory visits rose steadily over the 12-month baseline period, to a peak of four visits in the month prior to WRS/WRP (Fig. 2a). Patients in the WRRx and LSI cohorts experienced relatively stable counts of ambulatory visits over the 12-month baseline period with an increase in the month prior to initiation of an AOM or a lifestyle intervention, respectively. Mean monthly ER visits were rare and remained relatively constant across the baseline period, particularly among patients in the LSI, WRRx, and WRS cohorts (Fig. 2b). Inpatient stays were rare and appeared relatively stable across the 12-month baseline period for all cohorts (Fig. 2c).

3.4. Multivariable analyses

3.4.1. Demographic and clinical characteristics

In the multinomial logit model, patients who lived in the Midwest, South, or West (compared to the Northeast) had significantly higher odds of being treated with an AOM, WRP, or WRS than an LSI (Fig. 3a, b, c). Males and patients with an index year between 2016 and 2019 had significantly lower odds of receiving an AOM, WRP, or WRS compared to LSI. With increased age (compared to patients aged 18–29 years), patients had higher odds of receiving an AOM and lower odds of having a WRP or WRS compared to LSI. Patients with a Charlson comorbidity score of 1 (compared to 0) had significantly lower odds of having a WRP or WRS compared to LSI, whereas patients with a Charlson comorbidity score ≥ 2 had significantly higher odds.

3.4.2. Obesity-related complications

Patients who had cardiovascular risk factors, respiratory disorders, pain disorders, or mental health conditions had significantly higher odds of being treated with an AOM, WRP, or WRS than an LSI, patients with T2DM had higher odds of treatment with a WRP or WRS compared to LSI, and patients with ASCVD had higher odds of treatment with a WRS and lower odds of treatment with an AOM compared to LSI. Additionally, patients with reproductive conditions had higher odds of treatment with an AOM and lower odds of WRS compared to LSI.

Table 2
Patient demographics and baseline clinical characteristics.

	WRS (n = 18,036)	WRP (n = 1,172)	WRRx (n = 6,905)	LSI (n = 67,679)
Age, years, mean (SD)	48.3 (11.9)	47.8 (13.4)	50.1 (11.6)	51.2 (15.3)
Age category, years, n (%)				
18-29	1,025 (5.7)	101 (8.6)	261 (3.8)	5,810 (8.6)
30-39	3,363 (18.7)	211 (18.0)	1,031 (14.9)	10,162 (15.0)
40-49	5,275 (29.3)	332 (28.3)	2,022 (29.3)	14,799 (21.9)
50-59	4,952 (27.5)	301 (25.7)	2,117 (30.7)	16,243 (24.0)
60-69	2,901 (16.1)	162 (13.8)	1,144 (16.6)	11,807 (17.5)
≥70	520 (2.9)	65 (5.6)	330 (4.8)	8,858 (13.1)
Female sex, n (%)	13,524 (75.0)	859 (73.3)	5,341 (77.4)	41,061 (60.7)
Health plan type, n (%)				
Commercial	13,861 (76.9)	934 (79.7)	6,254 (90.6)	51,963 (76.8)
Medicare Advantage	4,175 (23.1)	238 (20.3)	651 (9.4)	15,716 (23.2)
Geographic region, n (%)				
Northeast	2,302 (12.8)	152 (13.0)	731 (10.6)	13,743 (20.3)
Midwest	4,161 (23.1)	253 (21.6)	1,714 (24.8)	12,430 (18.4)
South	9,059 (50.2)	633 (54.0)	3,501 (50.7)	32,210 (47.6)
West	2,514 (13.9)	134 (11.4)	959 (13.9)	9,296 (13.7)
Charlson comorbidity score, mean (SD)	1.1 (1.4)	1.0 (1.5)	0.5 (1.0)	0.6 (1.2)
Index year, n (%)				
2012-2015	8,721 (48.4)	960 (81.9)	2,791 (40.4)	24,373 (36.0)
2016-2019	9,315 (51.6)	212 (18.1)	4,114 (59.6)	43,306 (64.0)
BMI category, n (%)				
Valid n	**17,995**	**1,075**	**4,812**	**67,676**
≥40.0 kg/m^2	17,943 (99.7)	1,030 (95.8)	1,756 (36.5)	21,849 (32.3)
30.0 – < 40.0 kg/m^2	45 (0.3)	36 (3.4)	2,668 (55.4)	36,210 (53.5)
25.0 – < 30.0 kg/m^2	7 (0.04)	9 (0.8)	388 (8.1)	9,617 (14.2)

BMI, body mass index; LSI, lifestyle intervention; WRP, weight reduction procedure; WRRx, weight reduction pharmacotherapy; WRS, weight reduction surgery.

4. Discussion

The current study aimed to provide insights into the utilization of treatment modalities for the management of overweight and obesity and the patient characteristics that potentially influence clinical decision-making. Obesity is a leading cause of preventable death [29], and despite predictions of worsening prevalence [2], effective treatment options remain under-utilized [30]. This lends to the need to better understand factors that influence clinical decision-making [31,32] in order to develop healthcare approaches that improve the management of overweight and obesity [33] and outcomes for weight and ORCs [34]. In this study, age, sex, BMI, ORCs, and Charlson comorbidity score appeared to influence clinical decision-making. Overall, study results suggest WRP and WRS had greater odds of use in patients with more severe obesity and a higher comorbidity burden, whereas the use of AOMs appeared to be associated with distinct patient populations. Males were less likely to receive any of the weight management treatments compared with women. Finally, our findings indicate the lack of consistent application of evidence-based recommendations in clinical decision-making.

Patients in the WRS cohort had the highest mean BMI and highest prevalence of ORCs in most instances. After adjustment for patient demographic and clinical characteristics, the presence of cardiovascular risk factors, mental health diagnoses, respiratory conditions, and pain conditions were associated with receipt of a more intense treatment modality compared to LSI. Patients preparing for WRS are carefully evaluated for their readiness for surgery and anesthesia, so there may have been diagnosis bias where ORCs are identified more frequently at preoperative appointments [35]. Additionally, nearly all patients in the WRS cohort had a BMI ≥ 40 (≥ 99%); thus, in addition to diagnosis bias, the descriptive finding that patients with more ORCs were treated with higher intensity treatment modalities may be due relationship between higher BMI and a greater prevalence of ORCs [6,17]. Due to the colinear relationship between BMI and treatment modality, we could not adjust for BMI in the multinomial logit model investigating the association between patient characteristics and treatment modality.

Patients in the WRRx cohort had the highest prevalence of diagnoses for reproductive conditions, consistent with data from the National Health and Nutrition Examination Survey [20]. The odds of AOM use, compared to LSI, were significantly lower for patients with Medicare Advantage insurance coverage. This is likely due to the expanded coverage to include intensive behavioral therapy for weight reduction by Medicare Advantage in 2011 and a lack of coverage for AOMs. Our regression model found that patients with cardiovascular risk factors had an increased likelihood of receiving AOMs; however, those with established ASCVD were less likely to receive AOMs and more likely to receive WRS. One possible explanation for this is the lack of clear data that weight reduction with a pharmacologic treatment can improve cardiovascular outcomes [36], while WRS has demonstrated clear cardiovascular outcome benefits [37]. Similarly, the presence of T2DM had a strong association with receiving WRS, but not AOMs. The data for the benefit of WRS in patients with T2DM is much stronger than the evidence for AOMs [38]. Compared to LSI, use of AOMs in older patients was more likely than WRP/WRS. This may be due to perceptions of risk in older patients. Data on WRS have shown that elderly patients lose less weight [39–41] and have lower rates of remission for diabetes mellitus, hypertension, dyslipidemia, and gastroesophageal reflux [41] than younger patients, possibly making them less favorable candidates for some providers; conversely, several studies have provided evidence that weight reduction and a decrease in ORCs and mortality of patients ≥ 55 years of age has been comparable to the overall WRS population [42–44].

Overall, male patients were less likely to receive any treatment modality for weight management compared with women. A retrospective study of patients who underwent WRS from 1998 to 2010 found that only 20% were male despite a similar prevalence of obesity between genders [45]. It is thought that women may be less satisfied with their health and more aware of the health complications as a result of obesity, thus seek more aggressive weight loss treatments earlier in life; whereas men tend to wait until they have more health complications [45,46].

With respect to clinical practice, the vast majority of patients eligible for WRS do not receive it [47]. In the United States, approximately 40% of patients with obesity are considered class 2 or 3 [48,49]. According to Bays, more than 62% of patients with class 2 or 3 obesity have ≥ 1 ORC, meeting guideline recommendations for WRS [50]. Yet, our data show that 99% of patients who had WRS had class 3 obesity. One potential explanation for this finding is that providers may be delaying obesity treatment until a BMI ≥ 40 is reached, despite the likely presence of ORCs. The practice of delaying weight management treatment until a higher BMI threshold than those recommended by evidence-based treatment guidelines has been met has been previously reported among healthcare providers [24,25].

Additionally, patients with a high mortality risk (Charlson comorbidity score ≥ 2) were more likely to receive WRS and WRP and less likely to receive AOMs as their most intense treatment modality when compared to LSI. This suggests that interventions do not escalate in a

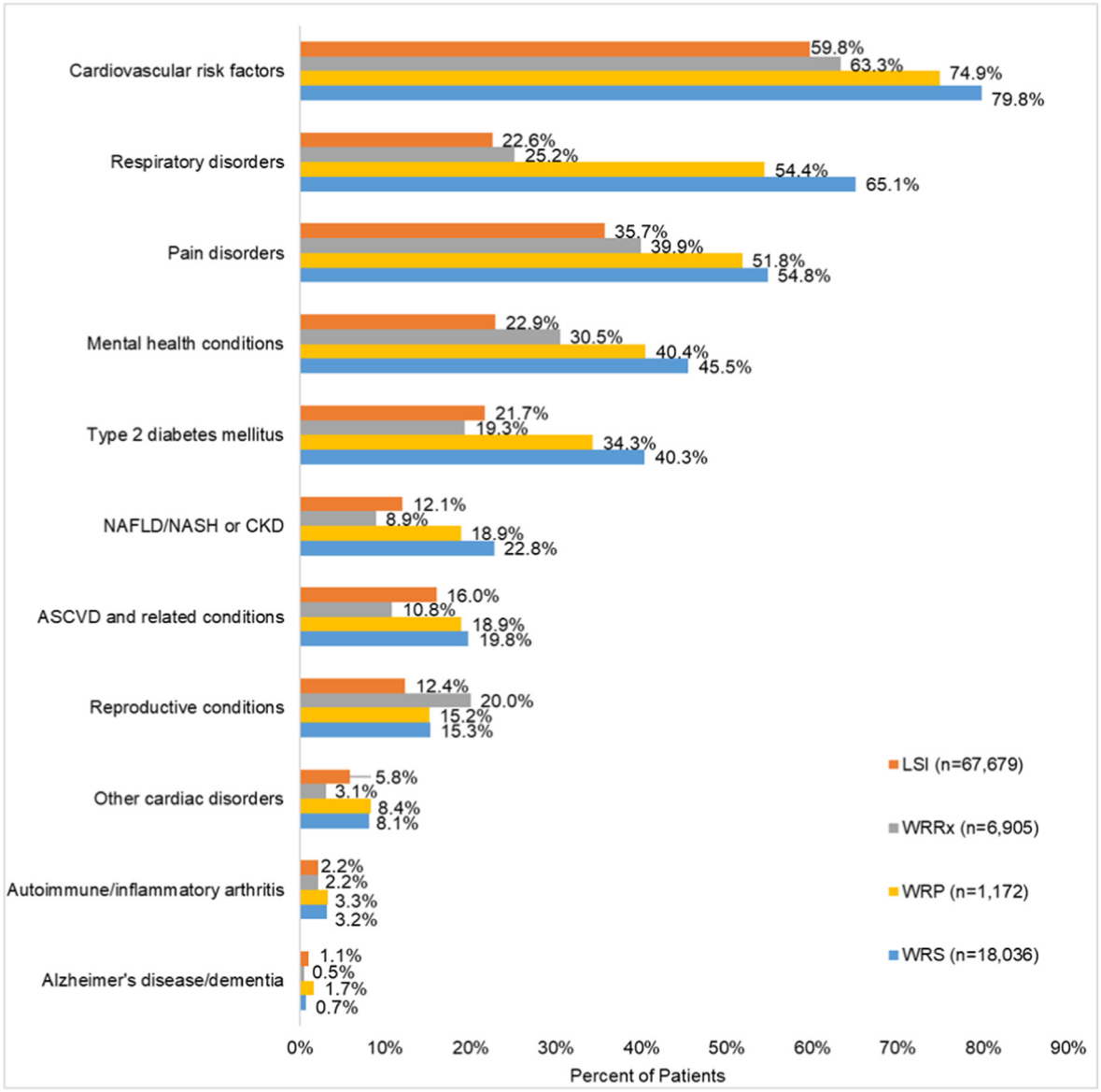


Fig. 1. Top obesity-related complications

[1]Includes dyslipidemia and hypertension; [2]Includes asthma and sleep apnea; [3]Includes osteoarthritis and back pain; [4]Includes depression and anxiety; [5]Includes atherosclerotic cardiovascular disease, cerebrovascular disease, ischemic heart disease, and peripheral arterial disease; [6]Includes hypogonadism, polycystic ovarian syndrome, and female infertility; [7]Includes atrial fibrillation/flutter and heart failure; [8]Includes rheumatoid arthritis, ankylosing spondylitis, enteropathic arthropathy, and psoriatic arthritis

ASCVD, atherosclerotic cardiovascular disease; CKD, chronic kidney disease; LSI, lifestyle intervention; NAFLD, nonalcoholic fatty liver disease; NASH, nonalcoholic steatohepatitis; WRP, weight reduction procedure, WRRx, weight reduction pharmacotherapy; WRS, weight reduction surgery. Fig. 2. Baseline healthcare resource utilization.

stepwise manner and other factors, such as medically needed weight reduction and burden of ORCs, are likely contributing to clinical decision-making. Further support comes from the finding that less than 1% of patients undergoing WRS and WRP had evidence of AOM use during the 1-year baseline period. In the clinical decision process for WRS, some guidelines recommend that pharmacotherapy should be offered to patients based on severity of ORCs [5].

Guidelines recommend LSI as the foundation of obesity management to which adjunct therapies may be added; however, in the year preceding the index weight reduction treatment, LSIs were documented prior to WRS in one out of three patients, decreasing to one out of six in patients with a WRP and one out of 28 patients receiving an AOM. Clinical practice guidelines for overweight and obesity recommend that when LSI alone does not provide clinically meaningful benefit, adjunct therapy such as AOMs or WRS are considered for the patient [4,5,7,8]; however, in the current study, the low utilization of LSIs and AOMs prior to WRS and WRP supports under-utilization and/or barriers to these treatment modalities. It is possible that patients may have received an LSI or AOM prior to the 12-month baseline period or received them from a cash-based program or through supplemental insurance coverage, where the supplemental claims were from a payer that was not included in the Optum Research Database. Historically, the safety of AOMs has been

Table 3
Baseline utilization of weight management treatment.

Baseline Weight Management Treatment[a]	WRS (n = 18,036)	WRP (n = 1,172)	WRRx (n = 6,905)	LSI (n = 67,679)
LSI, n (%)	5,781 (32.1)	195 (16.6)	245 (3.6)	–
AOM, n (%)	109 (0.6)	5 (0.4)	–	–
Number of fills, mean (SD)	0.01 (0.2)	0.01 (0.1)	–	–
ST-AOM, n (%)	199 (1.1)	9 (0.8)	–	–
Number of fills, mean (SD)	0.03 (0.4)	0.02 (0.4)	–	–

AOM, anti-obesity medication; LSI, lifestyle intervention; ST-AOM, short-term anti-obesity medication; WRP, weight reduction procedure; WRRx, weight reduction pharmacotherapy; WRS, weight reduction surgery.

[a] Available for treatments of lesser intensity than index weight management treatment.

controversial, including removal of multiple AOMs from the market due to serious adverse drug reactions [51]. This has contributed to uneasiness with AOMs among patients and providers. Ongoing research documenting the evidence of benefits of AOMs, including in high-risk populations such as ASCVD [52], would support clinical decision-making for AOMs. Weight reduction surgery has shown improvement in outcomes including all-cause mortality and diabetes remission, which have remained for over a decade after the initial surgery [53,54]; however, only a small percentage of eligible patients undergo WRS, including only 1 in 50 eligible patients with T2DM [37]. Previously cited barriers to weight management treatment have included financial access and cost and a lack of clinical resources, provider and patient knowledge of evidence-based treatment guidelines, recognition of obesity as a chronic disease, and provider confidence in long-term benefit and safety [22,25,55–60]; however, effective solutions to address these barriers remain limited [61].

4.1. Limitations

This study was conducted using administrative claims data, which is associated with certain inherent limitations. BMI ranges were captured via ICD-9/ICD-10 diagnosis codes. Previous studies having investigated the validity of these codes for classifying BMI in the general population found high positive predictive values, but low sensitivity with obesity being commonly underreported [62–64]. BMI measurements in patients with ORCs and those with class II and III obesity had higher sensitivity [63,64]. Medication use was based on the presence of a pharmacy claim, thus, medications received over the counter or outside of the health plan through samples, manufacturer-provided coupons, or other discount programs were not included in the study. Additionally, LSI interventions that were available through community resources (eg, YMCA) or only through direct payment (eg, commercial weight loss programs) would not have been included in the analysis. The data presented in this study were a "snapshot in time" and do not show the entire patient journey. Observational bias likely contributed to the current findings as patients planning for invasive treatments, particularly surgery, received pre-treatment medical and mental health evaluations. Lastly, this study was conducted in a large, US managed care population and may not be representative of all patients with overweight and obesity.

5. Conclusions

There is a multifaceted relationship between patient characteristics and clinical decision-making around weight management treatment modalities. Our data reinforce previously published reports documenting higher BMI and ORC burden thresholds in patients who receive weight management treatment compared to thresholds recommended by evidence-based guidelines, potentially due to clinical decision-making. Our data also suggest practice patterns are consistent with the existing data documenting the benefit of WRS, but not AOMs, in patients with ASCVD and T2DM. This study provides additional understanding of weight management treatment utilization and supports previous research

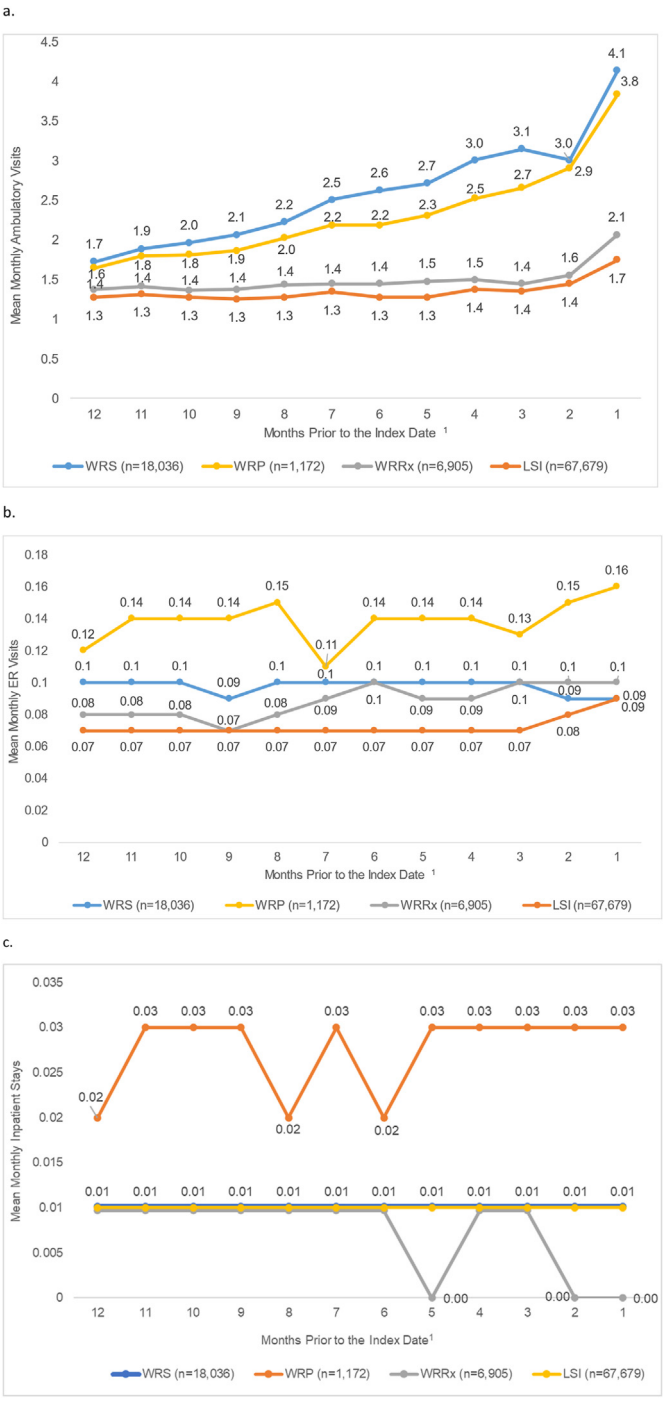
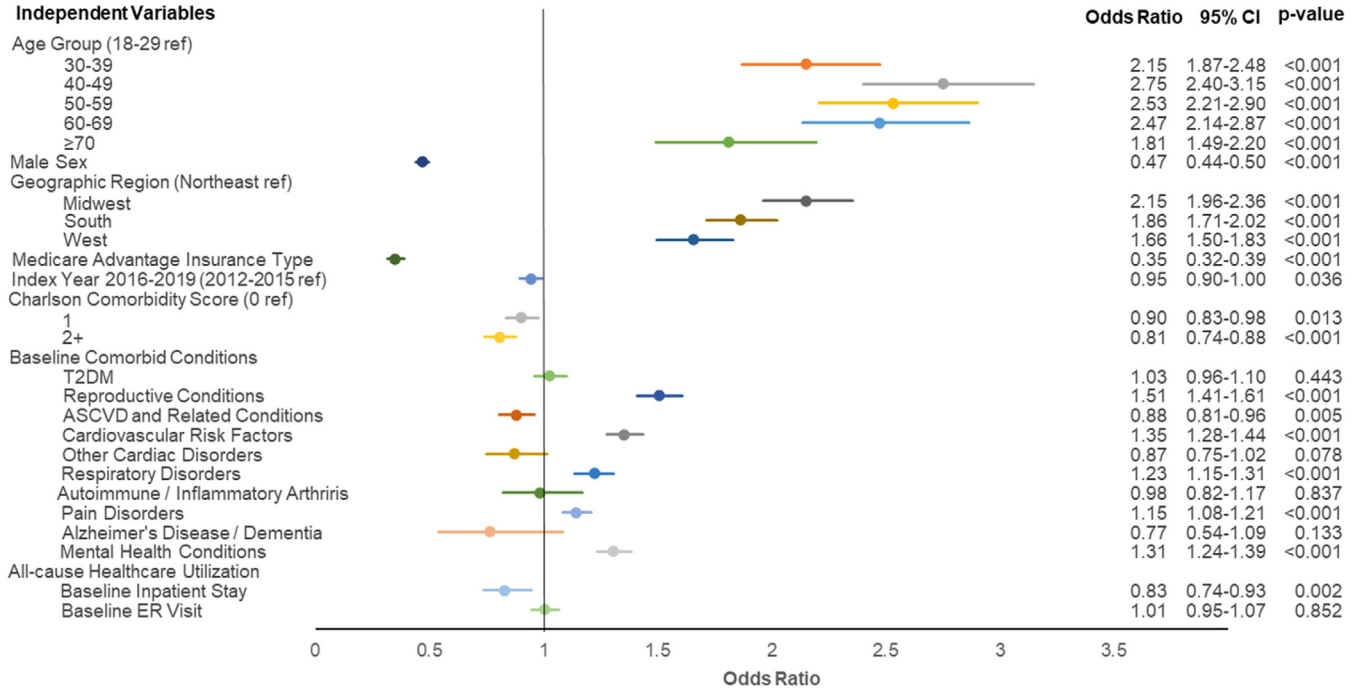


Fig. 2. Healthcare resource utilization
2a. Mean monthly ambulatory visits. 2b. Mean monthly emergency room visit. 2c. Mean monthly inpatient stays. [1]Index date was the first claim for the greatest intensity weight management intervention received, LSI, lifestyle intervention; WRP, weight reduction procedure; WRRx, weight reduction pharmacotherapy; WRS, weight reduction surgery.

a.



b.

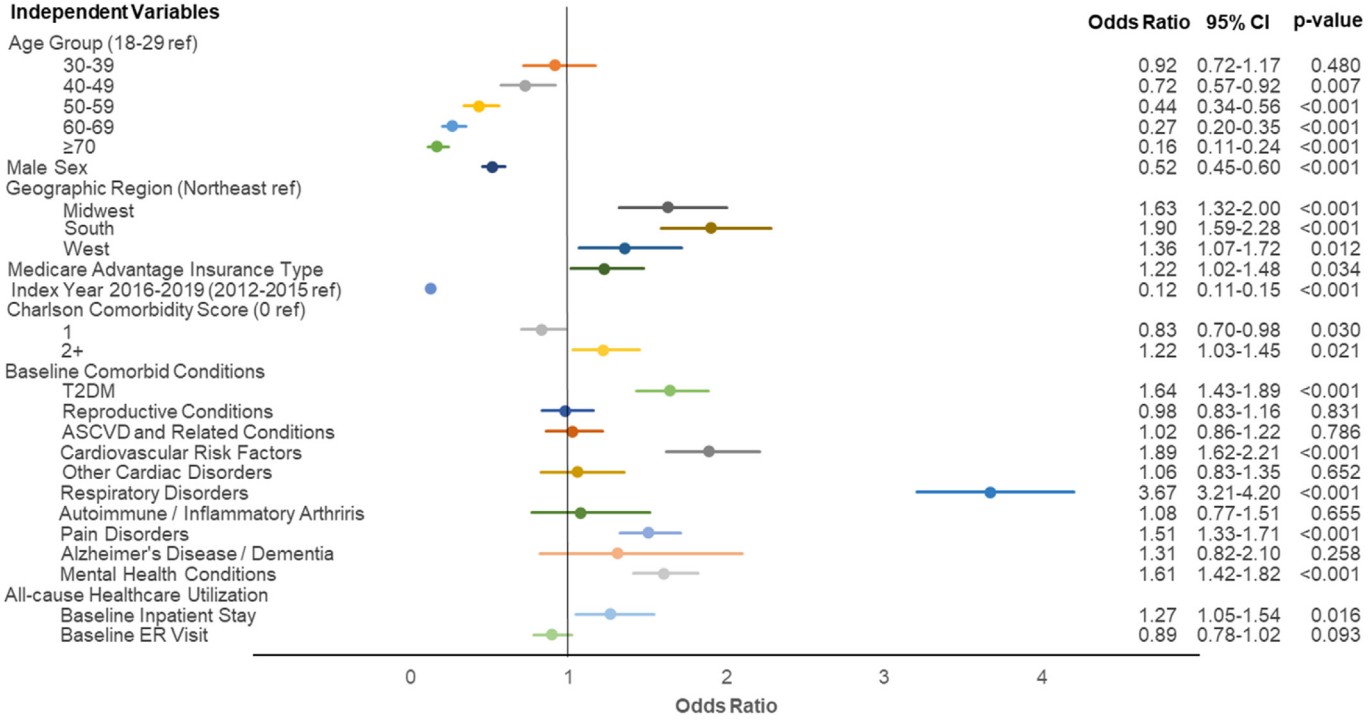


Fig. 3. Multinomial logit model of the association between patient characteristics and treatment modality received[1], 3a. WRRx versus LSI, 3b. WRP versus LSI, 3c. WRS versus LSI, [1]All overall p-values for each variable were significant across the models, with the exception of other cardiac disorders and autoimmune/inflammatory arthritis. ASCVD, atherosclerotic cardiovascular disease; ER, emergency room; T2DM, type 2 diabetes mellitus.

c.

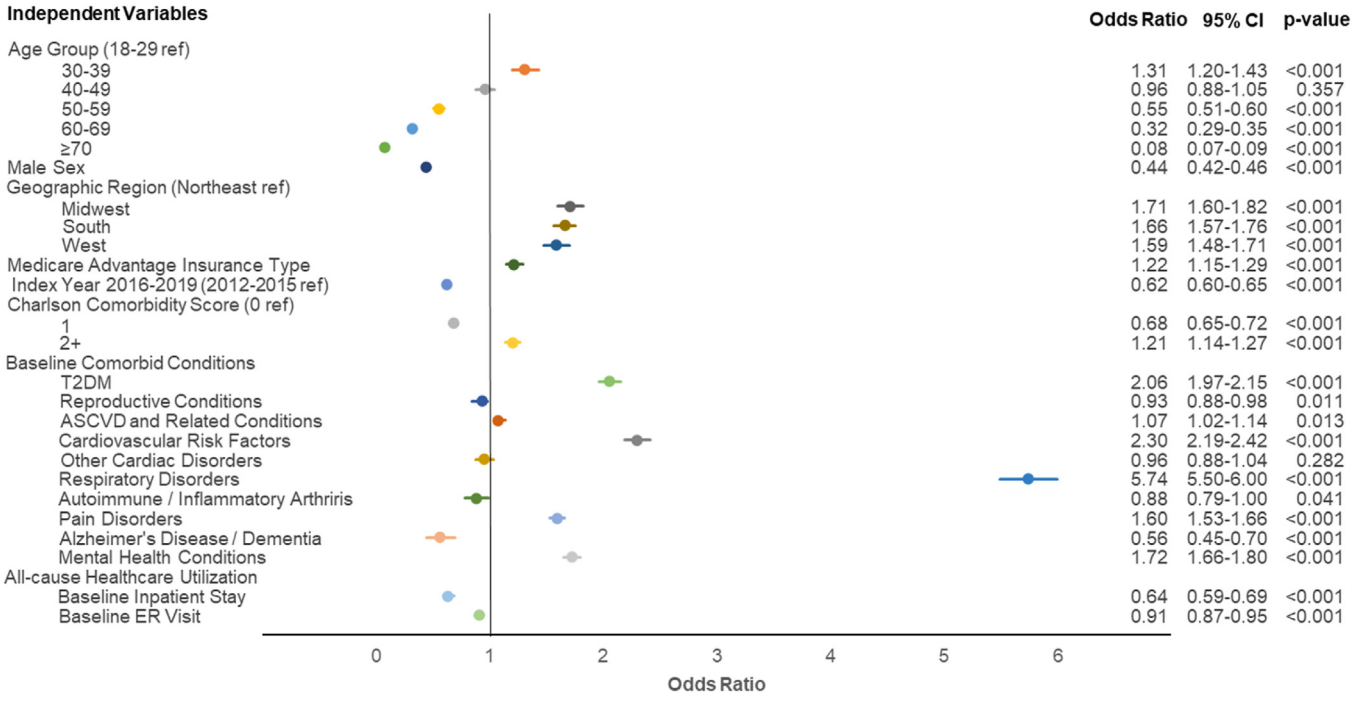


Fig. 3. (*continued*).

to address gaps and opportunities to improve care. Further research is needed to understand how healthcare providers and patients select weight management treatment modalities and to support providers and patients in evidence-based shared decision-making for chronic weight management.

Author contributions

The concept of the submission was by HK, JPS, JB, JPD, NNG, LB, and NA. HK, JPS, JB, EKB, NNG, and LB participated in the methodology design. Statistical analyses were performed by EKB and NNG. NNG, CC, and JF provided project administration. HK, JPS, JB, JPD, EKB, NNG, LB, CC, JF, and NA reviewed, edited, and approved the final submission.

Ethical review

This submission represents original work and authors have appropriately cited included works. The manuscript has only been submitted to *Obesity Pillars* and is not under consideration elsewhere. Institutional review board approval or waiver of approval was not required for this study because the study data were secondary and de-identified in accordance with the United States Department of Health and Human Services Privacy Rule's requirements for de-identification codified at 45C.F R. § 164.514(b).

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Declaration of competing interest

H Kan, J Bae, J Dunn, C Chinthammit, and N Ahmad are employees of Eli Lilly and Company. J Ford was an employee of Eli Lilly and Company at the time the study was conducted and is a current employee of Agios Pharmaceuticals. J Swindle was an employee at Optum at the time the study was conducted and is a current employee of Evidera. E Buysman and N Gronroos are employees of Optum. L Bengtson was an employee of Optum at the time the study was conducted and is a current employee of Boehringer Ingelheim. Optum received funding from Eli Lilly and Company to conduct the study.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.obpill.2023.100072.

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