Patients eligible and referred for bariatric surgery in southeastern Ontario

Retrospective cohort study

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Abstract

Objective To evaluate the proportion of eligible individuals, within one health region in Ontario, who were referred for publicly funded medical and surgical weight-loss interventions (MSWLI).

Design A retrospective cohort study that used primary care data from the Canadian Primary Care Sentinel Surveillance Network (CPCSSN) and referral data from the Ontario Bariatric Network (OBN).

Setting Primary care practices within southeastern Ontario that contribute data to CPCSSN.

Participants Patients with class II (body mass index [BMI] 35.0 to 39.9 kg/m^2) or III (BMI ≥ 40 kg/m^2) obesity who were eligible for referral to the OBN for MSWLI.

Main outcome measures Primary care data about patients within the CPCSSN database were linked to referral records within the OBN database using 3 indirect identifiers to determine the proportion of patients with class II and III obesity who were referred to the OBN for MSWLI. An adjusted multivariate logistic regression model was used to determine the most significant predictors of referral.

Results Of the 87 276 patients within one health region in Ontario, 15 526 (17.8%) patients had class II or III obesity and were eligible for referral for MSWLI. Only 966 out of those 15 526 (6.2%) patients were actually referred for MSWLI. In the multivariate regression analysis, BMI had the strongest association with referral in terms of adjusted odds ratio (AOR), varying from 2.50 (95% CI 2.04 to 3.06) for a BMI of 40.0 to 44.9 kg/m^2, to 5.15 (95% CI 4.21 to 6.30) for a BMI of 50.0 kg/m^2 or greater. Referral was more likely for female than male patients (AOR = 2.18; 95% CI 1.86 to 2.57), those living rurally than for urban dwellers (AOR = 1.39; 95% CI 1.20 to 1.60), and those aged 30 to 39 (AOR = 1.61; 95% CI 1.24 to 2.09) and 40 to 49 (AOR = 1.53; 95% CI 1.18 to 1.98) compared with other age groups.

Conclusion Within one health region in Ontario, the referral rate of patients with class II and III obesity for MSWLI was low. Our findings highlight the need for further research to understand and address the barriers to referral of patients with class II and III obesity for MSWLI.

Editor's key points

- The objectives of this study were to estimate the prevalence of class II and III obesity among primary care patients within a geographic region of one local health authority in Ontario, to determine the proportion of eligible patients with class II and III obesity who were referred for publicly funded medical and surgical weight-loss interventions (MSWLI), and to explore patient factors associated with a referral for MSWLI.
- The proportion of patients with class II or III obesity among the studied population was 17.8%. Of the patients eligible for referral, only 6.2% had a record of a referral to the Ontario Bariatric Network.
- The multivariate regression analysis revealed that body mass index (BMI) had the strongest association with MSWLI referral among the independent variables. Those in the highest BMI category (≥ 50 kg/m^2) were 5.15 (95% CI 4.21 to 6.30) times more likely to be referred for MSWLI than those with a BMI between 35.0 and 39.9 kg/m^2.

Points de repère du rédacteur

- Cette étude avait pour objectifs d'estimer la prévalence de l'obésité de classes II et III chez les patients en soins primaires dans une région géographique d'une autorité sanitaire locale en Ontario, de déterminer la proportion de patients admissibles dont l'obésité était de classe II ou III qui ont été envoyés en consultation pour des interventions médicales et chirurgicales aux fins de perte pondérale (IMCPP) financées par le secteur public, et d'explorer les facteurs spécifiques aux patients associés à une demande de consultation pour des IMCPP.
- La proportion de patients dont l'obésité était classée II ou III dans la population à l'étude se situait à 17,8 %. Parmi les patients admissibles à une consultation, seulement 6,2 % avaient un dossier de demande d'aiguillage auprès du Réseau ontarien des services bariatriques.
- L'analyse de régression multivariée a révélé que l'indice de masse corporelle (IMC) était l'association la plus forte avec une demande de consultation pour des IMCPP parmi les variables indépendantes. Ceux dans la catégorie d'IMC la plus élevée (≥ 50 kg/m^2) étaient 5,15 (IC à 95 % de 4,21 à 6,30) fois plus susceptibles d'être envoyés en consultation pour des IMCPP que ceux dont l'IMC se situait entre 35,0 et 39,9 kg/m^2.

Patients admissibles, aiguillés vers la chirurgie bariatrique dans le sud-est de l'Ontario

Étude rétrospective de cohortes

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Résumé

Objectif Évaluer la proportion de personnes admissibles dans une région sanitaire de l'Ontario qui ont été aiguillées vers des interventions médicales et chirurgicales aux fins de perte pondérale (IMCPP) financées par le secteur public.

Type d'étude Une étude rétrospective de cohortes à l'aide de données sur les soins primaires obtenues du Réseau canadien de surveillance sentinelle en soins primaires (RCSSSP) et de données sur les demandes de consultation auprès du Réseau ontarien des services bariatriques (ROSB).

Contexte Des cliniques de soins primaires dans la région du sud-est de l'Ontario qui fournissent des données au RCSSSP.

Participants Les patients dont l'obésité était de classe II (indice de masse corporelle [IMC] de 35,0 à 39,9 kg/m^2) ou de classe III (IMC de ≥ 40 kg/m^2) qui étaient admissibles à une demande de consultation auprès du ROSB pour des IMCPP.

Principaux paramètres à l'étude Les données sur les soins primaires concernant les patients dans la base de données du RCSSSP ont été reliées aux dossiers des demandes de consultation dans la base de données du ROSB à l'aide de 3 identifiants indirects pour déterminer la proportion de patients ayant une obésité de classes II et III qui ont été aiguillés vers le ROSB pour des IMCPP. Un modèle de régression logistique multivariée rajusté a été utilisé pour déterminer les facteurs de prédiction les plus significatifs d'une demande de consultation.

Résultats Parmi les 87 276 patients d'une région sanitaire en Ontario, 15 526 (17,8 %) patients avaient une obésité de classe II ou III et étaient admissibles à une consultation pour des IMCPP. Seulement 966 (6,2 %) parmi les 15 526 patients ont été effectivement aiguillés pour des IMCPP. Dans l'analyse de régression multivariée, l'IMC était le facteur le plus fortement associé à la demande de consultation sur le plan du rapport de cotes rajusté (RCR), variant de 2,50 (IC à 95 % de 2,04 à 3,06) pour un IMC de 40,0 à 44,9 kg/m^2, à 5,15 (IC à 95 % de 4,21 à 6,30) pour un IMC de 50,0 kg/m^2 ou plus. Il était plus probable que les demandes de consultation concernent des femmes plutôt que des hommes (RCR = 2,18; IC à 95 % de 1,86 à 2,57), les personnes vivant en milieu rural plutôt qu'en milieu urbain (RCR = 1,39; IC à 95 % de 1,20 à 1,60), et les personnes âgées de 30 à 39 ans (RCR = 1,61; IC à 95 % de 1,24 à 2,09) et de 40 à 49 ans (RCR = 1,53; IC à 95 % de 1,18 à 1,98) par rapport aux autres groupes d'âge.

Conclusion Dans une région sanitaire en Ontario, le taux d'aiguillage pour des IMCPP chez les patients dont l'obésité se situait dans les classes II et III était faible. Nos constatations font valoir la nécessité de faire d'autres recherches pour comprendre et réduire les obstacles à l'aiguillage des patients obèses de classes II et III vers des IMCPP.

Obesity has become a leading cause of morbidity and mortality, reaching epidemic proportions in the past decade.[1,2] It is a complex heterogenic disorder that has genetic, environmental, and behavioural causes.[3] Achieving sustained and clinically relevant weight loss can be extremely difficult. Bariatric surgery is an intervention that has proven to achieve clinically significant weight-loss results, with individuals maintaining a loss of 20% to 30% of their total body weight.[3]

The benefits and cost-effectiveness of bariatric surgery have been well established.[4,5] In Canada, the demand for bariatric surgery has grown substantially, and many provinces have set up bariatric programs to provide care closer to home and to eliminate the cost of sending patients out of country for bariatric surgery.[1,6] The province of Ontario has identified access to bariatric surgery as a priority and has increased funding to establish publicly funded medical and surgical weight-loss interventions (MSWLI) in specialized high-volume centres with multidisciplinary care teams (Bariatric Centres of Excellence [BCoE]).[2] The Ontario Bariatric Network (OBN) implemented a centralized referral portal to improve patient allocation and increase access to BCoE.[2] In order to access publicly funded MSWLI in Ontario, eligible patients must be referred to the centralized OBN system, usually by their primary care providers. Eligibility for MSWLI is defined by the National Institutes of Health criteria as any patient with class II obesity (body mass index [BMI] 35 to 39.9 kg/m^2) with an obesity-related comorbidity (coronary disease, hyperlipidemia, type 2 diabetes mellitus, hypertension, diagnosed sleep apnea, intractable gastroesophageal reflux disease, pseudotumour cerebri) or class III obesity (BMI ≥40 kg/m^2).[2] Ontario's centralized referral process for MSWLI led to a 313% increase in the number of bariatric surgeries performed between 2006 and 2013.[3]

Although the effectiveness of bariatric surgery has been well established in the literature, this intervention is still underused in North America.[7,8] A 2016 survey of family physicians in Ontario found that 70.2% of respondents had referred less than 5% of their eligible patients.[7] In the United States, less than 1% of individuals eligible for bariatric surgery undergo the procedure.[8] Estimates from Canadian data range from 0.1% of individuals in low-use neighbourhoods to 1% in higher-use areas.[9] There is also a considerable underuse of bariatric surgery among men, who actually have a higher prevalence and severity of obesity-related comorbidities such as diabetes mellitus, metabolic syndrome, and other associated cardiovascular diseases.[10]

The objectives of this study were to estimate the prevalence of class II and III obesity among primary care patients within the geographic region of one local health authority in Ontario, to determine the proportion of eligible patients with class II and III obesity who were referred for publicly funded MSWLI, and to explore patient factors associated with a referral for MSWLI.

Methods

Databases

This was a retrospective observational study that used patient data within the Eastern Ontario Network (EON) database to determine the proportion of patients eligible for referral for MSWLI. The EON is one of the practice-based research networks (PBRN) of the Canadian Primary Care Sentinel Surveillance Network (CPCSSN), which is a network of 11 PBRNs across Canada that collects de-identified clinical data from the electronic medical records (EMR) of participating primary care providers. The primary care providers who contribute their patient data to CPCSSN are a convenience sample of family physicians and nurse practitioners. These CPCSSN practitioners are younger and practice more often in academic centres than their non-CPCSSN colleagues.[11] The patients within the CPCSSN database are somewhat representative of the general population, but are typical of a primary care study group in that they are older and more likely to be women.[11]

The EON has active involvement and engagement from 146 primary care providers who are responsible for approximately 200 000 patients. Most, but not all, of the patients with records within the EON database reside within the geographic area of one local health authority, the South Eastern Local Health Integration Network (SELHIN). It is estimated that EON represents around one-third of the approximately 495 000 residents of the SELHIN.[12] Within the boundaries of this local health authority, there is one BCoE (Kingston, Ont), and the maximum distance a patient residing within the SELHIN could be from this BCoE is approximately 200 km.

The OBN was established in 2009 as part of the Ontario Bariatric Services Strategy initiated by the Ontario Ministry of Health and Long-Term Care. The OBN maintains a referral database that contains demographic and clinical characteristics of all patients in Ontario being referred for publicly funded MWSLI. Patients being referred for MSWLI in Ontario must be referred to the OBN through an online referral portal that gathers patient demographic and clinical information in a standardized and structured format. For this reason, the OBN has a robust and comprehensive database of patients referred for MSWLI in Ontario. The database includes information on past medical history, such as serious cardiovascular events or psychiatric illnesses, smoking history, relevant comorbidities, and previous weight-loss attempts.

Eligibility for referral for MSWLI

The EON database was queried for the number of patients, 18 years and older, who met the definition of eligibility for referral for publicly funded MSWLI, as a proportion of all patients who visited their primary care providers between 2012 and 2017. The inclusion criteria for eligibility for

referral for MSWLI were class III obesity (BMI ≥40 kg/m^2) or class II obesity (BMI 35 to 39.9 kg/m^2) with an obesity-related comorbidity (eg, diabetes, hypertension, osteoarthritis, or dyslipidemia). Patients could not be identified as eligible for referral if they did not have a recorded BMI between 2012 and 2017 or if their record was missing sex, birth date, or postal code.

Database linkage

After identifying patients eligible for referral for MSWLI in the EON database, a linkage was conducted between the EON and OBN databases to determine the proportion that was referred to the OBN for MSWLI. The OBN provided a de-identified data set that included any patient referred for MSWLI who had a postal code within the SELHIN. The 2 de-identified databases were linked using 3 common variables (indirect identifiers): sex, full postal code, and month and year of birth. A record pair was classified as a match if the 2 records agreed on all 3 demographic characteristics and the record pair was uniquely identified (no other record pair matched on the same set of values).[13] As a metric for the reliability of the linkage, the number of patients within the primary care sample (EON database) that agreed on all 3 indirect identifiers was calculated to determine the proportion of patients within the sample who could not be uniquely identified using these demographic characteristics.

Independent variables

Demographic characteristics. Age, as of the beginning of the study period (2012), was categorized into 10-year intervals for ease of interpretation. Sex was binary. Body mass index was categorized into 4 clinically relevant groups: 35.0 to 39.9 kg/m^2, 40.0 to 44.9 kg/m^2, 45.0 to 49.9 kg/m^2, and ≥50 kg/m^2 or greater. A patient's location, rural or urban, was determined based on the second digit of the postal code. A postal code with a zero in the second position indicates a rural location or an area where the population is not concentrated but dispersed at a low density. If a patient had a postal code without a zero in the second position they were classified as living in an urban area.

Clinical characteristics. Patients were classified as having an obesity-related comorbidity if they met the case definition criteria for hypertension, diabetes, osteoarthritis, or dyslipidemia. These 4 validated disease algorithms rely on billing, diagnoses, medications, and laboratory information documented in the EMR.[14] For patients identified as having diabetes, their most recent (before referral or the end of study period) hemoglobin A_{1c} level was determined and categorized into 3 clinically relevant groups: ≤7.0%, 7.1% to 9.0%, and >9.0%. Last, a patient was classified as taking antihypertensive or antidiabetic medications if there was at least 1 prescription for a medication classified under Anatomical Therapeutic Chemical codes C02 (antihypertensive) or A10 (antidiabetic) before the end of the study period or referral to the OBN.

Dependent variable

The outcome of interest was referral for MSWLI, which was determined by linking primary care patients within the EON to the referral data from the OBN.

Analysis

We used descriptive statistics to compare basic demographic and clinical characteristics of the study population (patients with class II and III obesity) who were referred for MSWLI compared with patients who were eligible to be, but who were not, referred. Frequencies and distributions of all independent variables were determined and a bivariate analysis was conducted using a χ^2 test. Multiple logistic regression was conducted with referral as the primary outcome (yes or no) and demographic and clinical characteristics as independent variables. Adjusted odds ratios (AORs) with 95% CIs were calculated. All covariates were included in the model to explore significant associations with a referral for MSWLI. All analyses were performed in SAS statistical software, version 9.6.

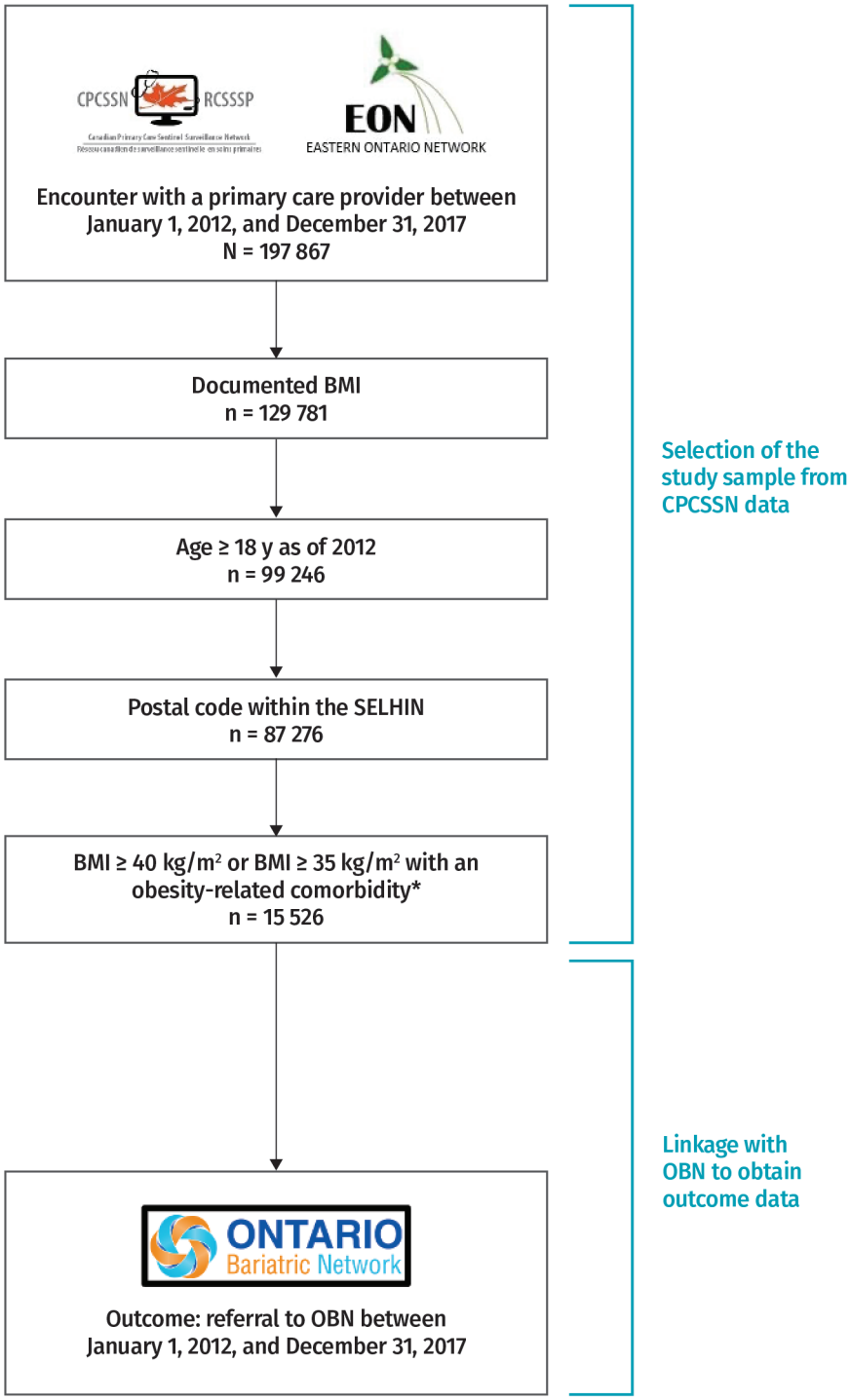
Ethics approval

This study was approved by the Queen's University Health Sciences and Affiliated Teaching Hospitals Research Ethics Board.

Results

There were 197 867 unique patients within the EON database who had an encounter with a CPCSSN-participating primary care provider between January 1, 2012, and December 31, 2017. Of these, 87 276 (44.1%) were 18 years or older, lived within the study region (SELHIN), and had a documented BMI. There were 15 526 (17.8%) patients with class II or III obesity among this population of patients in primary care. These individuals met the National Institutes of Health criteria for referral for MSWLI and could have been referred by their primary care provider to the OBN (**Figure 1**). Of the 15 526 patients eligible for referral, only 966 (6.2%) had a record of a referral to the OBN. The mean (SD) age of those eligible for referral for MSWLI was 52.7 (15.1) years; 40.5% were male and 31.0% were from a rural community (**Table 1**). Comparatively, primary care patients were significantly younger, with a mean (SD) age of 50.7 (17.7) years (P<.0001). There was a greater proportion of male patients (42.9%, P<.0001) and significantly fewer living in a rural area (29.0%, P<.0001). Additional characteristics of the population eligible for referral for MSWLI are described in **Table 1**.

Figure 1. Flow of patients in the primary care cohort and linkage to the referral database



BMI—body mass index, CPCSSN—Canadian Primary Care Sentinel Surveillance Network, OBN—Ontario Bariatric Network, SELHIN—South Eastern Local Health Integration Network.

*Hypertension, diabetes, osteoarthritis, or dyslipidemia.

Table 1. Comparison of patients referred and not referred for medical and surgical weight-loss interventions

CHARACTERISTICS	TOTAL ELIGIBLE, N (%) (N = 15 526)	REFERRAL		χ^2 TEST *P* VALUE
		NO, N (%) (n = 14 560)	YES, N (%) (n = 966)	
Age, y				< .0001
• 18-29	1284 (8.3)	1189 (8.2)	95 (9.8)	
• 30-39	1876 (12.1)	1673 (11.5)	203 (21.0)	
• 40-49	3031 (19.5)	2747 (18.9)	284 (29.4)	
• 50-59	3888 (25.0)	3614 (24.8)	274 (29.4)	
• 60-69	3461 (22.3)	3357 (23.1)	104 (10.8)	
• ≥ 70	1986 (12.8)	1980 (13.3)	6 (0.62)	
Sex, % male	6292 (40.5)	6074 (41.7)	218 (22.6)	< .0001
Average (SD) BMI, kg/m^2	45.6 (19.8)	45.5 (20.1)	48.2 (12.7)	< .0001
Location				< .0001
• Rural	4820 (31.0)	4465 (30.7)	355 (36.7)	
• Urban	10 706 (69.0)	10 095 (69.3)	611 (63.2)	
Hypertension	7474 (48.1)	7082 (48.6)	345 (35.7)	< .0001
Osteoarthritis	4475 (28.8)	4221 (29.0)	254 (26.3)	.0732
Diabetes	5494 (35.4)	5149 (35.4)	345 (35.7)	.8255
HbA_{1c} level, %				.3241
• ≤ 7.0	2483 (47.0)	2335 (47.0)	148 (47.4)	
• 7.1-9.0	2169 (41.1)	2055 (41.4)	114 (36.7)	
• > 9.0	629 (11.9)	579 (11.6)	50 (16.0)	
Dyslipidemia	9843 (63.4)	9302 (63.9)	541 (56.0)	< .0001
BMI, kg/m^2				< .0001
• 35-39.9	7192 (46.3)	7022 (48.2)	170 (17.6)	
• 40.0-44.9	4029 (25.9)	3765 (25.9)	264 (27.3)	
• 45.0-49.9	1854 (11.9)	1627 (11.1)	230 (23.8)	
• ≥ 50.0	2451 (15.8)	2149 (14.8)	302 (31.3)	
Antihypertensive prescription*	303 (1.9)	288 (2.0)	15 (1.5)	.3549
Antidiabetic prescription*	4299 (27.7)	4015 (27.6)	284 (29.4)	.2199

BMI—body mass index, HbA_{1c}—hemoglobin A_{1c}.
*At least 1 prescription.

During the study period, there were 6115 referrals to the OBN for MSWLI for patients residing within the study region (SELHIN) boundary. Of the 15 526 patients, 4.75% had the same values for all 3 indirect identifiers (linkage variables), and these patients were discarded as they could not be uniquely identified. After linking the de-identified databases using the 3 indirect identifiers, there were 966 unique matches.

Of the 966 patients who were referred for MSWLI, 688 (71.2%) were referred for bariatric surgery and 278 (28.8%) were referred to the medical weight-loss program. A comparison of the characteristics between those referred and those not referred is described in **Table 1**. Of note, there were no statistically significant differences in the proportion of patients with diabetes or who were taking antihypertensive or antihyperglycemic medications between those referred for MSWLI and those who were not referred (**Table 1**).

The multivariate regression analysis revealed that BMI had the strongest association with MSWLI referral among the independent variables (**Table 2**). Those in the highest BMI category (≥ 50 kg/m^2) were

Table 2. Multivariate logistic regression (fully adjusted) model for the outcome of referral to the Ontario Bariatric Network for medical and surgical weight-loss interventions

		95% CI		
VARIABLE	ODDS RATIO	LOWER	UPPER	*P* VALUE
Age, y				
• 18-29	Reference			
• 30-39	1.61	1.24	2.09	.0003
• 40-49	1.53	1.18	1.98	.0013
• 50-59	1.03	0.78	1.35	.8341
• 60-69	0.40	0.29	0.56	<.0001
• ≥70	0.04	0.02	0.09	<.0001
Sex				
• Male	Reference			
• Female	2.18	1.86	2.57	<.0001
BMI, kg/m^2				
• 35.0-39.9	Reference			
• 40.0-44.9	2.50	2.04	3.06	<.0001
• 45.0-49.9	4.65	3.77	5.75	<.0001
• ≥50.0	5.15	4.21	6.30	<.0001
Location				
• Urban	Reference			
• Rural	1.39	1.20	1.60	<.0001
Diabetes				
• No	Reference			
• Yes	1.23	0.96	1.57	.1007
Hypertension				
• No	Reference			
• Yes	1.14	0.98	1.32	.0888
Osteoarthritis				
• No	Reference			
• Yes	1.26	1.07	1.48	.0064
Dyslipidemia				
• No	Reference			
• Yes	1.13	0.97	1.30	.1058
Antihypertensive prescription				
• No	Reference			
• Yes	0.70	0.40	1.20	.1953
Antidiabetic prescription				
• No	Reference			
• Yes	1.23	0.95	1.60	.1085

BMI—body mass index.

5.15 (95% CI 4.21 to 6.30) times more likely to be referred for MSWLI than those with a BMI between 35.0 and 39.9 kg/m^2. Patients 30 to 50 years old, women, and those living in rural areas were significantly more likely to be referred for MSWLI (**Table 2**).

Discussion

The proportion of patients with class II and III obesity within the sample of primary care patients in the study region was 17.8%. Linkage to referral data from the OBN determined that only 6.2% of all eligible patients (966 out of 15526) with class II or III obesity were referred for MSWLI by their primary care providers. The regression model revealed that younger patients, women, and those with a higher BMI were more likely to be referred for MSWLI.

Previous research on referral rates for bariatric surgery has used survey studies evaluating physicians' attitudes and practices regarding the treatment of patients with morbid obesity.[15-18] One self-report study found that family physicians referred 21.9% of their patients with morbid obesity for bariatric surgery, and another study demonstrated that 75% of respondents had been referred for bariatric surgery in the past.[16,18] The low referral rate determined in our study suggests that these self-reported referral rates might be an overestimate. Our results are more congruent with findings from a survey of family practitioners that found that only 9% commonly referred their patients with morbid obesity for bariatric surgery, despite 1 in 4 of their patients having a BMI of 35 kg/m^2 or greater.[17] Furthermore, a study in which primary care providers in Ontario were interviewed found that just 9 of the 20 participants mentioned bariatric surgery as a weight-loss approach, with most stating that it is a last resort only used upon request by the patient.[15] These results are concerning in light of a 2017 Canadian report that used secondary clinical data to evaluate surgery completion rates and found that bariatric surgery is only performed for 1 in 178 (0.56%) eligible adults in Ontario.[19] Consequently, most patients referred for bariatric surgery in our study will likely not have completed the required assessments, preoperative testing, education sessions, and surgical consultations and will have gone on to have the operation, showing that MSWLI remains underused in our health region.

There was a clear difference in the propensity to refer patients with class II and III obesity for MSWLI based on age. Our data showed that patients between 30 and 50 years of age were most likely to be referred by their primary care providers. While the optimal age for a patient to undergo bariatric surgery is unknown, several studies have shown that younger patients have superior weight-loss outcomes and comorbidity resolution, and lower perioperative mortality.[20-22] Bariatric surgery in patients older than 55 has also been shown to achieve weight loss, reduction in comorbidities, and reduction in mortality comparable to the general bariatric population.[23] Future research should focus on investigating why patients between 30 and 50 years of age are more likely to be referred, as this does not appear to be evidence based.

We found that individuals in each increasingly higher BMI bracket were incrementally more likely to be referred for MSWLI than individuals in the 35.0 to 39.9 kg/m^2 range. This increased propensity to refer for MSWLI with higher BMI might be secondary to the severity of obesity-related comorbidities and decreasing quality of life with increasing BMI.[24] As well, research has shown that bariatric surgery is often seen as an extreme option for weight loss in patients with morbid obesity; individuals with a lower BMI might not perceive MSWLI to be a viable treatment option.[15] Many patients and providers view bariatric surgery as a last resort in the treatment of obesity and not as a preventive intervention.[15,18]

In our study, there were significantly more female patients referred for MSWLI than male patients ($P<.0001$), which is consistent with previous studies that show a distinct sex disparity in those who undergo bariatric surgery and those who do not.[10,25-27] In 2013 to 2014, 3 out of every 4 patients (78%) who underwent bariatric surgery in Canada were female.[2] In contrast, the prevalence of obesity in Canada is actually slightly higher in men (21.8%) than in women (18.7%).[2] This suggests that there is underuse of MSWLI by men with class II and III obesity.

Our study found that those living in a rural area, as defined by their postal code, were more likely to be referred for MSWLI. This was an unexpected result, as previous research has shown that rural residents are less likely to receive bariatric surgery than their urban counterparts are.[2,28-32] Individuals living in rural areas are more likely to have obesity but less likely to have access to resources, education, and comprehensive in-person weight management and healthy living programs (alternatives to bariatric surgery).[2,31,32] Given the centralized referral system for publicly funded MSWLI in Ontario, it is possible that patients in rural Ontario are more likely to receive a referral for MSWLI (what was measured in our study) but might in fact be less likely to actually proceed with MSWLI owing to the distance from a BCoE. Evidence has shown that a patient's distance from a BCoE is an important factor in following through with MSWLI.[2,31,32] It should also be noted that the method used in our study to classify patients as rural or urban (postal code) was not a measure of distance between a patient's residence and the closest BCoE.

There are many factors that could be contributing to the low referral rate found in our study, including patients' perceptions of and attitudes toward MSWLI. The low referral rate might be reflective of the negative beliefs that some patients have about the efficacy and safety of bariatric surgery.[33-35] Survey studies have found

that 57% to 77% of those eligible for referral, depending on the population under study, are not receptive to bariatric surgery.[7,30,31] The top reasons cited include fear of surgical complications, a feeling of not needing surgery to lose weight, and fear of dying.[35] In fact, evidence is mounting that bariatric surgery is far more effective in producing clinically significant, sustainable weight loss than lifestyle changes or pharmacotherapy are.[29,32,35-37] In addition, observational research has found lower (approximately 40% to 50%) mortality after 1 to 5 years in those who receive surgery compared with matched control patients.[38,39] Patients' perceptions about bariatric surgery seem to be in contradiction to the literature on the efficacy and safety of contemporary bariatric surgery.

Primary care providers' beliefs, education, and experiences also play an important role in how often their patients are referred for MSWLI.[2,7,16,35] Many primary care providers have the perception that treating obesity is futile and might avoid addressing weight issues or postpone much-needed discussions.[15,31] Physicians have identified inadequate clinical training in obesity management as a barrier to appropriate care of patients with obesity.[7] Several studies have shown that, despite knowing the long-term effects of obesity, most primary care providers are not addressing or offering weight-loss treatments.[7,15-17,35]

Limitations

Our study has a number of important limitations to consider. First, approximately 35% of the active primary care population did not have a BMI measurement documented in their EMR. Primary care providers might be more likely to record BMI in those with health concerns related to obesity, which means those with missing BMI measurements might be more likely to be in the normal-weight category[40] and that the estimate of class II or III obesity in this primary care sample is an overestimate. However, it is also possible that the undocumented BMI measurements could be the result of individuals who are too heavy to be weighed using an average scale, which would suggest underreporting of the proportion of patients with class II or III obesity.

There might be some misclassification in the determination of those eligible or ineligible for MSWLI referral. We were unable to identify episodic and paroxysmal disorders (eg, sleep apnea) as comorbidities, or comorbidities for which there were no validated case definitions (eg, gastroesophageal reflux disease, nonalcoholic fatty liver disease). In addition, we did not account for natural weight loss or other exclusionary criteria (eg, pregnancy, psychological issues) that would have made participants ineligible to be referred for MSWLI. Furthermore, while our study included a measure of a patient's rural or urban location, there was no variable that accounted for the actual distance from the patient's residence to the closest BCoE. We also did not include any measure of socioeconomic status.

The record linkage of 2 de-identified databases using indirect identifiers (geographic location, sex, date of birth) was not manually reviewed or validated. In the primary care sample of patients with class II and III obesity, 4.75% paired with at least 1 other patient on all 3 indirect identifiers. Of these, 56 matched to an OBN record but had to be discarded because they could not be uniquely matched. This means that the 6.2% referral rate is likely an underestimation of the actual referral rate. In addition, true matches would have been missed if the patient moved and the recorded postal code differed between the OBN and the EON databases.

The 84% of referrals to OBN for patients residing within the SELHIN that were not matched to any patient within the EON database were assumed to belong to patients who received care from primary care providers who do not contribute any patient data to the CPCSSN project. The unmatched referral data might match to patients whose primary care data is collected by a provider that participates in another local CPCSSN network, as there are many patients who do not reside in close proximity to their primary care providers.

Last, it is important to note that our study only determined if a patient was referred to the OBN for MSWLI. We could not capture patients who were offered a referral for MSWLI and refused, nor the patients who actually followed through with MSWLI when the referral was made.

Conclusion

The referral rate of eligible patients with class II and III obesity for MSWLI is low in the geographic region of one local health authority in Ontario. To meaningfully reduce the burden of obesity in the Canadian health care system, the number of patients undergoing MSWLI needs to increase. Further research is needed to understand and address the barriers to referral for MSWLI.

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Contributors

Dr Barber contributed substantially to the conception and design of the study. He led the research team and provided valuable input on the direction and insight for the entire research program. **Ms Morkem** coordinated the research team, completed the analysis, and drafted the article. **Dr Dalgarno** substantially contributed to every stage of the study and critically revised the article for important intellectual content. **Dr Houlden** provided feedback and guidance on the design and development of the study and interpretation of the results. **Dr Smith** provided feedback and guidance on the design and development of the study and interpretation of the results. **Dr Anvari** contributed substantially to the acquisition of the data and provided critical input on the manuscript. **Dr Zevin** contributed substantially to the conception and design of the study. He led the research team and provided valuable input on the direction and insight of the entire research program. He critically revised the article for important intellectual content.

Competing interests

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