Received: 10 April 2023 | Revised: 10 October 2023 | Accepted: 12 October 2023

DOI: 10.1002/osp4.718

ORIGINAL ARTICLE

Obesity Science and Practice Open Access WILEY

A comparison of virtual and in person delivery of a full meal replacement program for obesity

Matthew Skeldon[1] | David Harris[2,3] | Robert Dent[2,4] | Judy Y. Shiau[2]

[1]Division of General Internal Medicine, Department of Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, Canada

[2]LEAF Weight Management Clinic, Division of Endocrinology and Metabolism, University of Ottawa, Ottawa, Ontario, Canada

[3]Richmond Metabolic & Bariatric Surgery Program, Richmond, British Columbia, Canada

[4]The Ottawa Hospital Weight Management Clinic, University of Ottawa, Ottawa, Ontario, Canada

Correspondence
Matthew Skeldon, Saskatoon Medical Group, 420 – 210 Avenue P South, Saskatoon, SK S7M2W2, Canada.
Email: mjs826@mail.usask.ca

Abstract

Objective: Full meal replacement (FMR) Intensive Lifestyle Interventions (ILI) have been used for weight management. However, predictors of efficacy with these programs are less clear. The primary objective was to assess weight loss predictors in a community-based FMR ILI program. A secondary objective was to determine if weight loss was different between virtual and in person ILI.

Methods: This was a retrospective cohort study involving 234 patients who started the program between 1 January 2016 and 3 March 2021. In the 24-week program, patients spent 12 weeks on FMR and then transitioned back to food for the remainder, with weekly follow up with a physician and group sessions with a dietitian. Visits were in person prior to March 2020 and virtual afterward.

Results: Patients' average age was 47.5 years (SD = 12.0) and 73.5% were female. Average weight loss was 14.3% (SD = 6.2%). There was no significant difference in weight loss between virtual and in person programs. Patients on a Glucagon-like Peptide-1 Receptor Agonist prior lost *less* weight. Other significant associations between groups were baseline Hemoglobin A_1C, classes attended, as well as the age since peak weight.

Conclusion: Weight loss from virtual ILI was not significantly different from person ILI. More research is needed to determine how to best stratify care as virtual or in person using FMR programs.

KEYWORDS
lifestyle modifications, weight loss, weight management program

1 | INTRODUCTION

Obesity rates have increased significantly in Canada and were 27.2% in 2017/2018.[1] Given its increasing prevalence, effective treatment of obesity is essential. One of the tools available to treat overweight and obesity is the use of partial or Full meal replacement (FMR) (PMR, FMR). The use of meal replacements can lead to greater weight loss and improvements in body composition.[2,3] These improvements can also be helpful in managing diabetes, leading to improved control or even diabetes remission.[4,5] The use of a structured multidisciplinary obesity therapy program with FMR has been shown to be a highly effective treatment of obesity and obesity-related diseases.[6] A previous randomized controlled trial reported patients on a FMR, medically managed program, had twice as much

weight loss and higher rates of clinically meaningful weight loss at 52 weeks compared to a reduced calorie food based program.[7] The use of meal replacements is supported in Canadian and European guidelines for managing obesity.[8,9]

Meal replacement use has also been reported in patients with type 2 diabetes and has been shown to produce more weight loss compared to individualized diet plans and reduce the use of diabetes medications.[10] The standard Optifast® 900 weight management programs in Canada are medically supervised, high intensity, behavioral intervention programs with frequent followup, combined with a low-calorie FMR diet of 900 kcal per day. It consists of a 24-week program, weekly meetings with allied health professionals and physicians, 12 weeks of FMR, followed by a transition phase with solid/liquid food, and ultimately a weight maintenance phase with solid food.[8]

The LEAF Weight Management Clinic (LEAF WMC) in Ottawa, East Ontario, is one of Canada's largest medically supervised, urban-community and academic-based, private weight management clinics. Since January 2016, the LEAF WMC has offered programs involving either FMR or PMR using Optifast® 900 shakes.

One of the biggest changes to the program at the clinic was due to the global pandemic, due to severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2, COVID-19). Prior to the pandemic, all services at LEAF WMC were in person. However, it was recognized that patients with obesity are at greater risk from COVID-19[11] and have more chronic complications from COVID-19.[12] Furthermore, funding and resources were also affected.[13] Due to generalized cycles of population lock-downs in Canada, the decision to move toward virtual care rather than in person was made. Virtual care, also referred to as telemedicine, allowed for the delivery of the program while maintaining social distancing from the patients. This shift was a common experience that affected many patients.[14] The benefits of virtual care in obesity management that existed prior to the pandemic have been demonstrated in numerous other studies.[13,15–18] The transition to virtual care was made by other obesity medicine providers due to the pandemic, with significant patient satisfaction.[19] It has been shown that virtual visits are similarly efficacious as well.[20]

The objective of this study was to determine the factors that may be associated with greater weight loss when undergoing an intensive lifestyle intervention. A secondary objective was to determine if there was a difference in weight loss between those who had completed the in person program prior to the pandemic compared with those who had participated in the program only virtually.

2 | METHODS

2.1 | Study design

This study was a retrospective electronic medical record chart review. The charts of all patients who had participated in the FMR program were individually reviewed. To be included in the study, patients must have been at least 18 years of age and have started the program between 1 January 2016 and 3 March 2021. Patients were excluded from the analysis if they had not attended at least 8 of 24 sessions. In the event that a patient did the program more than once, only their first attempt was included in the analysis.

2.2 | Participants

During chart review, 306 charts were identified for patients who had gone through LEAF WMC's Optifast® 900 FMR intensive lifestyle intervention program, as seen in Figure 1. Six charts were excluded from patients who had not completed the program before data analysis began. A further 10 charts were excluded as they had insufficient data and 12 charts were excluded as they represented patients who were doing the program for the second time. Of these remaining 278 charts, 30 were excluded for doing a 3rd version of the program, while 14 were excluded as they fell during the period when the program transitioned from being in person versus virtual. Overall, 234 individual patients were included in the study.

Demographics for patients collected from their initial appointment included past medical and surgical history, family history, peak lifetime weight, and age at peak lifetime weight. Medication use, for categories known to influence weight gain or weight loss, was noted. Weight was recorded at program start, weekly during the program, and as a percentage change in weight each week in comparison to program start. Prior enrollment in the publicly funded weight management program,[10] was also tracked.

2.3 | Intervention

In the FMR program, patients underwent a medically supervised intensive lifestyle intervention (ILI) with a low-calorie FMR diet of 900 kcal per day using Optifast® 900 (Nestlé Health Science). It consisted of a 24-week program, featuring weekly meetings with registered dietitians and physicians. While the meetings with physicians were individual, the sessions with the registered dietitian were done as group sessions. The first 12 weeks consisted of FMR, followed by a transition phase for 12 weeks where patients transitioned back to eat food and focused on weight maintenance. During the FMR phase, patients were allowed to consume 1-2 cups of green vegetables per day in addition to Optifast® 900. On 18 March 2020, the pandemic necessitated a transition from person sessions and MD visits to virtual care through Zoom (Zoom Video Communications, Inc.). In a virtual visit, patients would follow a private Zoom link to speak to a physician. Dietitian sessions were performed as group Zoom sessions.

At each visit during the STREAM program, patients' weight and waist circumference were collected. After the transition to virtual visits, weight and waist circumference was self-reported by the patients at each of their visits.

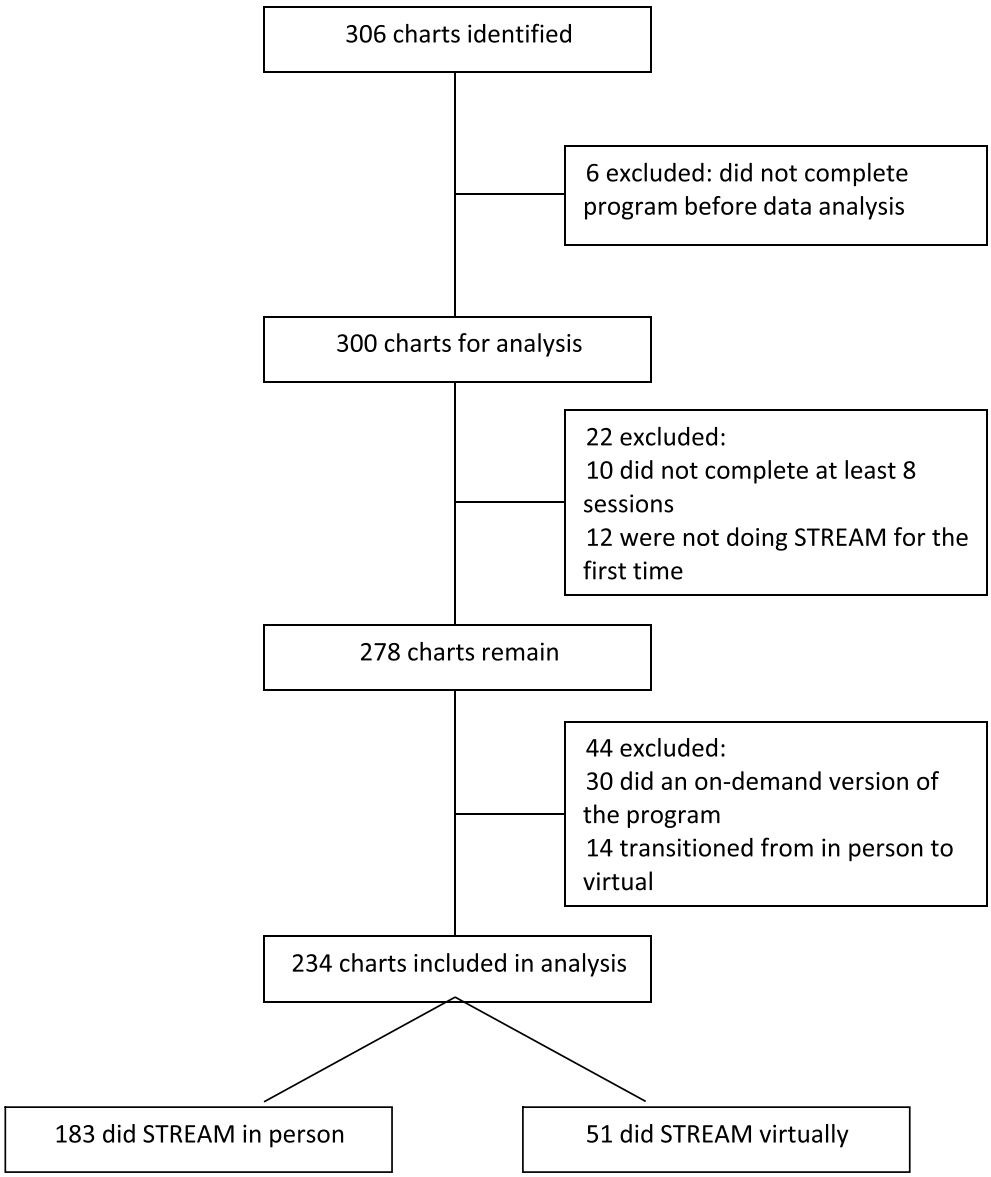

FIGURE 1 Flowchart showing chart review as well as exclusion process.

2.4 | Statistical analysis

Statistical analyses were performed at the Ottawa Methods Center. A *p*-value of less than 0.05 was considered significant. Since the assumption of the *T*-test was not satisfied for categorical variables, non-parametric methods, such as Kruskal–Wallis and Wilcoxon tests, were applied to investigate the association between final weight and categorical variables. For continuous variables, single variable ordinary regression (*t*-test) was applied to verify the association between continuous variables and final weight. For multivariate regression, a least squares mean model was used in the secondary analysis. This was done to correct for multiple testing in the primary analysis. A post-hoc analysis was performed using LibreOffice Calc (The Document Foundation) and an unpaired, 2-tailed Student's *T*-test.

3 | RESULTS

A total of 234 patients were included in this study. Baseline demographics are reported in Table 1. Of the patients, 26.5% were male and 73.5% were female. The average age was 47.5 years (SD = 12.0), with an average weight loss of 14.3% (SD = 6.2%). More than 75% of patients managed to achieve a ≥10% weight loss. The majority of patients (77.4%) did not have type 2 diabetes mellitus. The majority of patients had a family history of obesity (80.3%). In univariate analysis, only attendance in a virtual weight management program had a significant impact on weight loss. This accounted for a difference in weight loss of 15.7% (SD = 5.9%) versus 13.9% (SD = 6.3%) ($p = 0.0319$). However, this did not meet significance in secondary analysis ($p = 0.0625$) as reported in Table 2. Gender did trend close

TABLE 1 Baseline demographics.

Characteristic		*n* (%)	Average percent weight loss	Std dev	*p*-value
Average patient	Age (Std Dev)	47.5 (12.0)	14.3	6.2	
Weight loss ≥5%		218 (93.2)			
Weight loss ≥10%		177 (75.6)			
Weight loss ≥15%		104 (44.4)			
Weight loss ≥20%		48 (20.5)			
Gender	Male	62 (26.5)	15.6	7.2	0.0547
	Female	172 (73.5)	13.8	5.8	
History of T2DM	No	181 (77.4)	14.4	6.1	0.5071
	Yes	53 (22.6)	13.8	6.8	
History of CAD or CVA	No	225 (96.2)	14.2	6.2	0.5187
	Yes	9 (3.8)	15.4	6.7	
History of OSA	No	147 (62.8)	13.9	5.7	0.1961
	Yes	87 (37.2)	15.0	7.0	
History of bariatric surgery	No	225 (96.2)	14.4	6.3	0.3699
	Yes	8 (3.4)	12.4	5.7	
History of eating disorder	No	219 (93.6)	14.1	6.1	0.1387
	Yes	15 (6.4)	17.0	7.1	
Publicly funded program completion	No	179 (76.5)	14.6	6.3	0.1051
	Yes	55 (23.5)	13.3	6.0	
Onset of weight	Childhood	100 (42.7)	13.5	5.9	0.2775
	Puberty	32 (13.7)	15.5	7.8	
	Adulthood	97 (41.5)	14.6	5.9	
Family history of obesity	No	38 (16.2)	14.9	5.3	0.9017
	Yes	188 (80.3)	14.2	6.5	
	Adopted	4 (1.7)	13.5	4.0	
Program format	Virtual	51 (21.8)	15.7	5.9	**0.0319**
	In person	183 (78.2)	13.9	6.3	
Smoking status	Never	141 (60.3)	14.1	6.1	0.9827
	Current	17 (7.3)	14.9	5.9	
	Ex-smoker	73 (31.2)	14.5	6.7	

Note: Age is shown as an average, with a standard deviation in parentheses. For other values, it is presented as the count with a percentage in parentheses. Bolded values indicate statistical significance with $p < 0.05$.

Abbreviations: CAD, coronary artery disease; CVA, cerebrovascular accident; OSA, obstructive sleep apnea; Std Dev, standard deviation; T2DM, type 2 diabetes mellitus.

to near significance ($p = 0.0547$), with 15.6% (SD = 7.2%) weight loss in males compared to 13.8% (SD = 5.8%) in females.

Medication use and percentage weight loss are reported in Table 3. 46.6% of patients were taking at least one or more antidepressant at baseline. However, neither use of antidepressants ($p = 0.2211$) nor antipsychotics ($p = 0.1412$) significantly effected weight loss. 27.8% of patients were started on a medication for weight management during the program; however, the use of all weight loss medication therapy was not significantly correlated with weight loss ($p = 0.2003$). Interestingly and contrary to common clinical expectations, glucagon-like peptide-1 receptor agonist (GLP-1-RA) medication use at baseline was significantly correlated ($p = 0.0248$), with *less* weight loss in univariate analysis. This relationship held up in the secondary analysis ($p = 0.0285$), as reported in Table 4. Bupropion use was not significantly correlated ($p = 0.0537$) with less weight loss.

TABLE 2 Regression analysis for categorical variables.

Variable	Least square mean from model						
Smoking status	**Never**	**Current**	**Ex-smoker**	**Mean difference (95% CI) [A]**	**Mean difference (95% CI) [B]**	***p*-value [A]**	***p*-value [B]**
	14.12	14.85	14.50	−0.73 (−3.89, 2.43)	0.35 (−2.96, 3.66)	0.969	0.9968
Onset of weight	Childhood	Puberty	Adulthood	Mean difference (95% CI) [A]	Mean difference (95% CI) [B]	*p*-value [A]	*p*-value [B]
	13.53	15.46	14.58	−1.93 (−4.40, 0.54)	0.88 (−1.61, 3.37)	0.4215	0.8981
Family history of obesity	No	Yes	Adopted	Mean difference (95% CI) [A]	Mean difference (95% CI) [B]	*p*-value [A]	*p*-value [B]
	14.91	14.16	13.54	0.75 (−0.32, 1.81)	0.62 (−5.57, 6.81)	0.9087	0.9973
Program format	Virtual	In person	Mean difference (95% CI)	*p*-value			
	15.73	13.89	1.83 (−0.08, 3.76)	0.0625			
Medication started during program	No	Yes	Mean difference (95% CI)	*p*-value			
	14.66	13.34	1.32 (−0.46, 3.10)	0.1478			

Abbreviations: CI, Confidence Interval; For smoking status, Mean Difference A, comparison between Never and Current smoker; Mean Difference B, comparison between Current smoker and Ex-smoker; For onset of weight, Mean Difference A, comparison between Childhood and Puberty; Mean Difference B, comparison between Puberty and Adulthood; For Family history of obesity, Mean Difference A, comparison between No and Yes; Mean Difference B, comparison between Yes and Adopted.

TABLE 3 Medication history.

Characteristic		*n* (%)	Average percent weight loss	Std dev	*p*-value
Beta blocker use	No	212 (90.6)	14.4	6.3	0.2303
	Yes	22 (9.4)	12.9	5.5	
Insulin use	No	217 (92.7)	14.3	6.2	0.8422
	Yes	17 (7.3)	13.8	6.7	
GLP-1-RA use	No	214 (91.5)	14.6	6.3	**0.0248**
	Yes	20 (8.5)	11.4	4.9	
Bupropion use	No	213 (91.0)	14.5	6.2	0.0537
	Yes	21 (9.0)	11.8	6.4	
Antipsychotic use	No	213 (91.0)	14.5	6.2	0.1412
	Yes	21 (9.0)	12.1	6.0	
Antidepressant use	No	125 (53.4)	14.8	6.4	0.2211
	Yes	109 (46.6)	13.7	6.0	
Medication started during program	No	169 (72.2)	14.7	6.3	0.2003
	Yes	65 (27.8)	13.3	6.0	

Note: Bolded values indicate statistical significance with $p < 0.05$.

Abbreviations: GLP-1 RA, glucagon-like peptide-1 receptor agonist.

Effects due to some of the continuous variables are reported in Table 5. Higher A_1C at program start was associated with less weight loss ($p = 0.0125$), which did hold up in secondary analysis ($p < 0.0001$) as reported in Table 6. The age of the patient did not significantly affect weight loss. The number of years since peak weight was not significant in the univariate analysis but was found to be significant in the secondary analysis ($p < 0.0001$), with more years since peak weight giving less weight loss. One of the strongest

Variable	Least square mean from model			
Gender	Male	Female	Mean difference (95% CI)	*p*-value
	15.58	13.83	1.75	0.0577
History of T2DM	No	Yes		
	14.43	13.82	0.60	0.5382
History of CAD or CVA	No	Yes		
	14.25	15.38	−1.14	0.5916
History of OSA	No	Yes		
	13.88	14.97	−1.09	0.1979
History of bariatric surgery	No	Yes		
	14.37	12.39	1.98	0.3802
History of eating disorder	No	Yes		
	14.10	17.02	−2.92	0.0791
Beta blocker use	No	Yes		
	14.33	13.82	0.51	0.7478
GLP-1-RA use	No	Yes		
	14.56	11.38	3.19	0.0285
Bupropion use	No	Yes		
	14.54	11.75	2.79	0.0504
Antipsychotic use	No	Yes		
	14.50	12.13	2.37	0.0969
Antidepressant use	No	Yes		
	14.77	13.74	1.03	0.206
Publicly funded program completion	No	Yes		
	14.61	13.25	1.35	0.1591

Abbreviations: CAD, coronary artery disease; CI, Confidence Interval; CVA, cerebrovascular accident; GLP-1, RA; glucagon-like, peptide-1 receptor agonist; OSA, obstructive sleep apnea; T2DM, type 2 diabetes mellitus.

TABLE 4 Regression analysis for categorical variables continued.

TABLE 5 Continuous variables.

Variable	Total observations	Observations missing	Estimate	Std error	T value	*p*-value
Starting HbA_1C	231	3	−0.87917	0.34930	−2.52	**0.0125**
Years since peak weight	216	18	−0.14256	0.07706	−1.85	0.0657
Weight change at midpoint	229	5	1.32605	0.06229	21.29	**<0.0001**
Age at program start	234	0	0.02430	0.03400	0.71	0.4755
Classes attended total	234	0	0.80972	0.08965	9.03	**<0.0001**

Note: Bolded values indicate statistical significance with $p < 0.05$.
Abbreviations: HbA1C, hemoglobin A1C; Std, standard.

predictors of weight was with a higher number of classes attended ($p < 0.0001$ in both univariate and secondary analyses).

The virtual group attended more classes at 22.5 (SD = 2.7) classes on average compared to 19.1 (SD = 3.9) for those in person ($p < 0.0001$) (Table 7). More than half of the virtual group managed to achieve ≥15% total body weight loss, as seen in Figure 2.

4 | DISCUSSION

This study supports evidence that virtual care can be similarly efficacious as in person for FMR ILI. Weight loss in the virtual care group did trend toward significance, though it did not meet the threshold for significance. However, the virtual care group had higher

attendance on average than in person. Previous studies suggest better attendance and less attrition with virtual care rather than in person.[21] It was shown that higher attendance was associated with better weight loss, which has been similarly reported.[22] With a larger sample size, it is possible that virtual care might outperform in person care. Virtual care became primarily used for communication while the population was in pandemic lock down(s), and it is possible that this allowed certain highly motivated patients to focus on weight loss, more so than care being in person. The other possibility is that the shift to virtual care may have excluded patients who would have been less successful in the program. This data set was not able to elucidate these aspects; therefore, further studies are needed to tease this out.

Virtual care does have some drawbacks, however. Interacting with providers only at a distance might make patients have more trouble forming a strong connection.[23] Additionally, older adults may have more difficulty accessing virtual care if done through online videoconferencing.[24] Other barriers, such as digital literacy or socioeconomic status, might make virtual care less effective for some patients.[25]

There was a trend, that did not reach significance, for males to achieve more weight loss than females. This has been seen in some studies,[26] but not all.[22,27] Reassuringly, no significant differences were found for weight loss between those that had some common weight related comorbidities (diabetes, coronary artery disease, obstructive sleep apnea) and those that did not.

Regarding medications, it was looked at if being on certain medications at the start of the program led to worse weight loss. It is known that medications such as beta blockers[28] or most psychotropic medications[29] can cause weight gain. This was not found to be significant in this study. However, others, such as GLP-1-RA[30,31] or bupropion/naltrexone-bupropion[29,30] can cause weight loss. In this data, being on a GLP-1-RA at the start of the program was significantly associated with less weight loss, while being on bupropion trended toward less weight loss. This is contrary to the expected result as hunger modulatory medication therapy is thought to assist FMR ILI programs, as improved hunger control should lead to improved adherence to the FMR protocol. However, it is also possible that patients on these medications prior to the program already experienced a significant

TABLE 6 Regression analysis for continuous variables.

Variable	Least square mean from model age mean	*p*-value
Age	14.29	0.174
Years since peak weight	Years mean	*p*-value
	9.61	**<0.0001**
Starting HbA_1C	HbA_1c mean	*p*-value
	16.63	**<0.0001**
Starting BMI	BMI mean	*p*-value
	14.29	0.7168
Classes attended total	Class attended mean	*p*-value
	14.35	**<0.0001**

Note: Bolded values indicate statistical significance with $p < 0.05$.
Abbreviations: BMI, Body Mass Index; HbA_1C, Hemoglobin A_1C.

TABLE 7 Virtual versus In Person.

	Virtual	In person	Odds ratio	*p*-value
Classes attended	22.5 (2.7)	19.1 (3.9)		**<0.0001**
Weight loss ≥5%	96.1	91.8	2.2 (0.5–9.9)	0.3003
Weight loss ≥10%	82.4	73.8	1.7 (0.8–3.7)	0.2084
Weight loss ≥15%	58.8	40.4	2.1 (1.1–4.0)	**0.0194**
Weight loss ≥20%	29.4	18.0	1.9 (0.9 to 3.9)	0.0757

Note: For classes attended, data presented as a mean with a standard deviation. For Weight Loss categories, data is presented as a percentage who achieved that threshold of weight loss. Odds ratio is presented with 95% confidence intervals. Bolded values indicate statistical significance with $p < 0.05$.

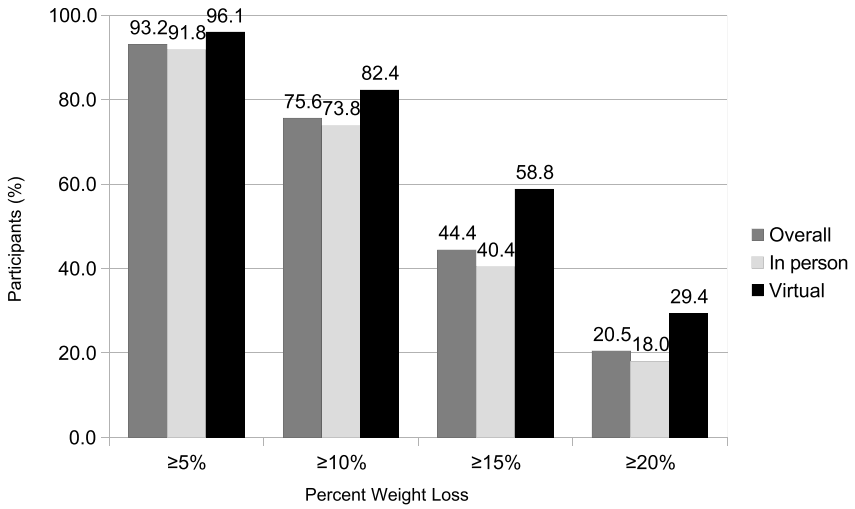

FIGURE 2 Percentage of participants who achieved weight loss thresholds.

weight loss, which could lead to less weight loss with a secondary intervention, such as meal replacement. Finally, being started on a medication for weight management during the program was not associated with more weight loss. One explanation for these findings could be that patients had more resistant obesity, as the medications were started most typically for inadequate weight loss trajectory. Previous studies examining the effect of medications on ILI programs are limited. In LOOK AHEAD, patients who were started on Orlistat as a response to lower than goal weight loss actually experienced less weight loss than predicted.[32] A more recent study from 2020 with a milk-based FMR did show that 14 of 18 patients on GLP-1-RA were able to stop them by program completion.[33] This could suggest that GLP-1-RA use was not felt to be contributing to weight loss in those patients. More studies are needed to determine the interaction between weight loss medications and ILI.

Age was not found to be a significant predictor of weight loss in the data. This does differ from prior studies showing older adults losing more weight.[26,27,34] It was also shown that having a lower HbA_1C level was associated with better weight loss. This was a different finding than a previous study involving a publicly funded program at the Ottawa Hospital.[10] The study did find that a longer time since patients were at their peak weight was associated with less weight loss. The time since peak weight is not typically reported in weight loss trials. A reason this might impact weight loss could be a metabolic adaptation. It has been shown that weight loss can reduce energy expenditure and resting metabolic rate.[35,36] One possibility is that due to a longer time passing since the patients had reached their highest ever weight, their metabolism may have slowed more than patients at their peak weight, rendering further weight loss more difficult.

This study has limitations, one of which is its nature as a retrospective cohort. The study was inappropriately powered to track incidence rates of rare obesity-related health factors, for example, impact of prior bariatric surgery or impact of eating disorders. Another weakness is that weights were measured at the clinic during the in-person cohort on a calibrated accurate clinic scale, but were self-reported during the virtual cohort from non-regulated at-home scales. This also raises the issue of reporter error in the virtual system. It has been seen that self-reported measurements tend to over-report height and under-report weight.[37,38]

This study does show that virtual programming offers effective weight loss. There are previous studies showing the effectiveness of virtual weight management programs,[39,40] including those showing it was equivalent to in person visits.[20,21] It remains to be seen if virtual care may become superior to in person for weight management. To better understand if virtual care may be preferable to in person care, more randomized studies must be performed.

5 | CONCLUSION

Community FMR ILI with Optifast® 900 was effective at achieving clinically significant weight loss. This study supports the use of a virtual environment to deliver such a program. More research and dedicated studies must be performed to determine if virtual programs might be superior to in person programs for the average patient.

ACKNOWLEDGMENTS

We thank the Ottawa Methods Center at The Ottawa Hospital Research Institute for their contribution to this publication.

CONFLICT OF INTEREST STATEMENT

We have no conflicts of interest to disclose.

CLINICAL TRIAL REGISTRATION

This did not meet the requirements to be registered as a clinical trial.

ORCID

Matthew Skeldon https://orcid.org/0000-0002-9946-271X

REFERENCES

1. Lytvyak E, Straube S, Modi R, Lee KK. Trends in obesity across Canada from 2005 to 2018: a consecutive cross-sectional population-based study. *CMAJ Open*. 2022;10(2):E439-E449. https://doi.org/10.9778/cmajo.20210205
2. Guo X, Xu Y, He H, et al. Effects of a meal replacement on body composition and metabolic parameters among subjects with overweight or obesity. *J Obes*. 2018;2018:1-10. https://doi.org/10.1155/2018/2837367
3. Astbury NM, Piernas C, Hartmann-Boyce J, Lapworth S, Aveyard P, Jebb SA. A systematic review and meta-analysis of the effectiveness of meal replacements for weight loss. *Obes Rev*. 2019;20(4):569-587. https://doi.org/10.1111/obr.12816
4. Noronha JC, Nishi SK, Braunstein CR, et al. The effect of liquid meal replacements on cardiometabolic risk factors in overweight/obese individuals with type 2 diabetes: a systematic review and meta-analysis of randomized controlled trials. *Diabetes Care*. 2019;42(5):767-776. https://doi.org/10.2337/dc18-2270
5. Brown A, Dornhorst A, McGowan B, et al. Low-energy total diet replacement intervention in patients with type 2 diabetes mellitus and obesity treated with insulin: a randomized trial. *BMJ Open Diabetes Res Care*. 2020;8(1):e001012. https://doi.org/10.1136/bmjdrc-2019-001012
6. Bischoff SC, Damms-Machado A, Betz C, et al. Multicenter evaluation of an interdisciplinary 52-week weight loss program for obesity with regard to body weight, comorbidities and quality of life—a prospective study. *Int J Obes*. 2012;36(4):614-624. https://doi.org/10.1038/ijo.2011.107
7. Ard JD, Lewis KH, Rothberg A, et al. Effectiveness of a total meal replacement program (OPTIFAST program) on weight loss: results from the OPTIWIN study. *Obesity*. 2019;27(1):22-29. https://doi.org/10.1002/oby.22303
8. Langlois MF, Freedhoff Y, Morin M.-P. Commercial Products and Programs in Obesity Management. Canadian Adult Obesity Clinical Practice Guidelines; 2020. Published June 11. Accessed 4 July 2022. https://obesitycanada.ca/guidelines/commercialproducts
9. Hassapidou M, Vlassopoulos A, Kalliostra M, et al. European association for the study of obesity position statement on medical nutrition therapy for the management of overweight and obesity in adults developed in collaboration with the European federation of the associations of dietitians. *Obes Facts*. 2022;16(1):11-28. https://doi.org/10.1159/000528083
10. Shiau JY, So DYF, Dent RR. Effects on diabetes medications, weight and glycated hemoglobin among adult patients with obesity and type

2 diabetes: 6-month observations from a full meal replacement, low-calorie diet weight management program. *Can J Diabetes*. 2018;42(1):56-60. https://doi.org/10.1016/j.jcjd.2017.03.006
11. Kwok S, Adam S, Ho JH, et al. Obesity: a critical risk factor in the COVID-19 pandemic. *Clin Obes*. 2020;28(6):e12403. Published online August. https://doi.org/10.1111/cob.12403
12. Aminian A, Bena J, Pantalone KM, Burguera B. Association of obesity with postacute sequelae of COVID-19. *Diabetes Obes Metabol*. 2021;15(9):2183-2188. Published online June. https://doi.org/10.1111/dom.14454
13. Nather K, Bolger F, DiModica L, et al. The impact of COVID-19 on obesity services across Europe: a physician survey. *Clin Obes*. 2021;13(5):e12474. Published online July. https://doi.org/10.1111/cob.12474
14. Dainty KN, Seaton MB, Estacio A, et al. Virtual specialist care during the COVID-19 pandemic: multimethod patient experience study. *JMIR Med Inf*. 2022;10(6):e37196. https://doi.org/10.2196/37196
15. Chao GF, Ehlers AP, Telem DA. Improving obesity treatment through telemedicine: increasing access to bariatric surgery. *Surg Obes Relat Dis*. 2021;17(1):9-11. https://doi.org/10.1016/j.soard.2020.09.012
16. Kahan S, Look M, Fitch A. The benefit of telemedicine in obesity care. *Obesity*. 2022;30(3):577-586. https://doi.org/10.1002/oby.23382
17. Minsky NC, Pachter D, Zacay G, et al. Managing obesity in lockdown: survey of health behaviors and telemedicine. *Nutrients*. 2021;13(4):1359. https://doi.org/10.3390/nu13041359
18. Shibuya K, Pantalone KM, Burguera B. Virtual shared medical appointments: a novel tool to treat obesity. *Endocr Pract*. 2018;24(12):1108-1109. https://doi.org/10.4158/1934-2403-24.12.1108
19. Lohnberg JA, Salcido L, Frayne S, et al. Rapid conversion to virtual obesity care in COVID-19: impact on patient care, interdisciplinary collaboration, and training. *Obes Sci Pract*. 2021;8(1):131-136. https://doi.org/10.1002/osp4.550
20. Griebeler ML, Butsch WS, Rodriguez P, et al. The use of virtual visits for obesity pharmacotherapy in patients with overweight or obesity compared with in-person encounters. *Obesity*. 2022;30(11):2194-2203. https://doi.org/10.1002/oby.23548
21. Taetzsch A, Gilhooly CH, Bukhari A, et al. Development of a videoconference-adapted version of the community diabetes prevention program, and comparison of weight loss with in-person program delivery. *Mil Med*. 2019;184(11-12):647-652. https://doi.org/10.1093/milmed/usz069
22. Kim J, Park SK, Lim YJ. Analysis of the factors affecting the success of weight reduction programs. *Yonsei Med J*. 2007;48(1):24-29. https://doi.org/10.3349/ymj.2007.48.1.24
23. Nayyar D, Pendrith C, Kishimoto V, et al. Quality of virtual care for ambulatory care sensitive conditions: patient and provider experiences. *Int J Med Inform*. 2022;165:104812. https://doi.org/10.1016/j.ijmedinf.2022.104812
24. Pang HYM, Zhao G, Kithulegoda N, Agarwal P, Ivers NM. Aligning virtual care in Canada with the needs of older adults. *Can J Aging / La Revue canadienne du vieillissement*. 2022;41(4):641-646. https://doi.org/10.1017/S0714980821000623
25. Mistry SK, Shaw M, Raffan F, et al. Inequity in access and delivery of virtual care interventions: a scoping review. *Int J Environ Res Publ Health*. 2022;19(15):9411. https://doi.org/10.3390/ijerph19159411
26. Bray GA, Krauss RM, Sacks FM, Qi L. Lessons learned from the POUNDS lost study: genetic, metabolic, and behavioral factors affecting changes in body weight, body composition, and cardiometabolic risk. *Curr Obes Rep*. 2019;8(3):262-283. https://doi.org/10.1007/s13679-019-00353-1
27. Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002;346(6):393-403. https://doi.org/10.1056/NEJMoa012512
28. Azar M, Nikpay M, Harper ME, McPherson R, Dent R. Adverse effects of β-blocker therapy on weight loss in response to a controlled dietary regimen. *Can J Cardiol*. 2016;32(10):1246.e21-1246.e26. https://doi.org/10.1016/j.cjca.2015.10.016
29. Dent R, Blackmore A, Peterson J, et al. In: Alessi-Severini S, ed. *Changes in Body Weight and Psychotropic Drugs: A Systematic Synthesis of the Literature*. Vol 7; 2012. PLoS ONE. https://doi.org/10.1371/journal.pone.00368896e36889.
30. Khera R, Murad MH, Chandar AK, et al. Association of pharmacological treatments for obesity with weight loss and adverse events: a systematic review and meta-analysis. *JAMA*. 2016;315(22):2424-2434. https://doi.org/10.1001/jama.2016.7602
31. Wilding JPH, Batterham RL, Calanna S, et al. Once-weekly semaglutide in adults with overweight or obesity. *N Engl J Med*. 2021;384(11):989-1002. https://doi.org/10.1056/NEJMoa2032183
32. Wadden TA, West DS, Neiberg RH, et al. One-year weight losses in the look AHEAD study: factors associated with success. *Obesity*. 2009;17(4):713-722. https://doi.org/10.1038/oby.2008.637
33. Rafey MF, Murphy CF, Abdalgwad R, et al. Effects of a milk-based meal replacement program on weight and metabolic characteristics in adults with severe obesity. *Diabetes Metab Syndr Obes*. 2020;13:197-205. https://doi.org/10.2147/DMSO.S226327
34. The Look AHEAD Research Group. Eight-year weight losses with an intensive lifestyle intervention: the look AHEAD study. *Obesity*. 2014;22(1):5-13. https://doi.org/10.1002/oby.20662
35. Fothergill E, Guo J, Howard L, et al. Persistent metabolic adaptation 6 years after the Biggest Loser competition. *Obesity*. 2016;24(8):1612-1619. https://doi.org/10.1002/oby.21538
36. Rosenbaum M, Hirsch J, Gallagher DA, Leibel RL. Long-term persistence of adaptive thermogenesis in subjects who have maintained a reduced body weight1. *Am J Clin Nutr*. 2008;88(4):906-912. https://doi.org/10.1093/ajcn/88.4.906
37. Gorber SC, Tremblay M, Moher D, Gorber B. A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. *Obes Rev*. 2007;8(4):307-326. https://doi.org/10.1111/j.1467-789X.2007.00347.x
38. Christian NJ, King WC, Yanovski SZ, Courcoulas AP, Belle SH. Validity of self-reported weights following bariatric surgery. *JAMA*. 2013;310(22):2454-2456. https://doi.org/10.1001/jama.2013.281043
39. Ahrendt AD, Kattelmann KK, Rector TS, Maddox DA. The effectiveness of telemedicine for weight management in the MOVE! Program. *J Rural Health*. 2014;30(1):113-119. https://doi.org/10.1111/jrh.12049
40. Barnason S, Zimmerman L, Schulz P, Pullen C, Schuelke S. Weight management telehealth intervention for overweight and obese rural cardiac rehabilitation participants: a randomized trial. *J Clin Nurs*. 2019;28(9-10):1808-1818. https://doi.org/10.1111/jocn.14784

How to cite this article: Skeldon M, Harris D, Dent R, Shiau JY. A comparison of virtual and in person delivery of a full meal replacement program for obesity. *Obes Sci Pract*. 2024;e718. https://doi.org/10.1002/osp4.718