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Original Research

Factors influencing adults to drop out of intensive lifestyle interventions for weight loss

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Abstract

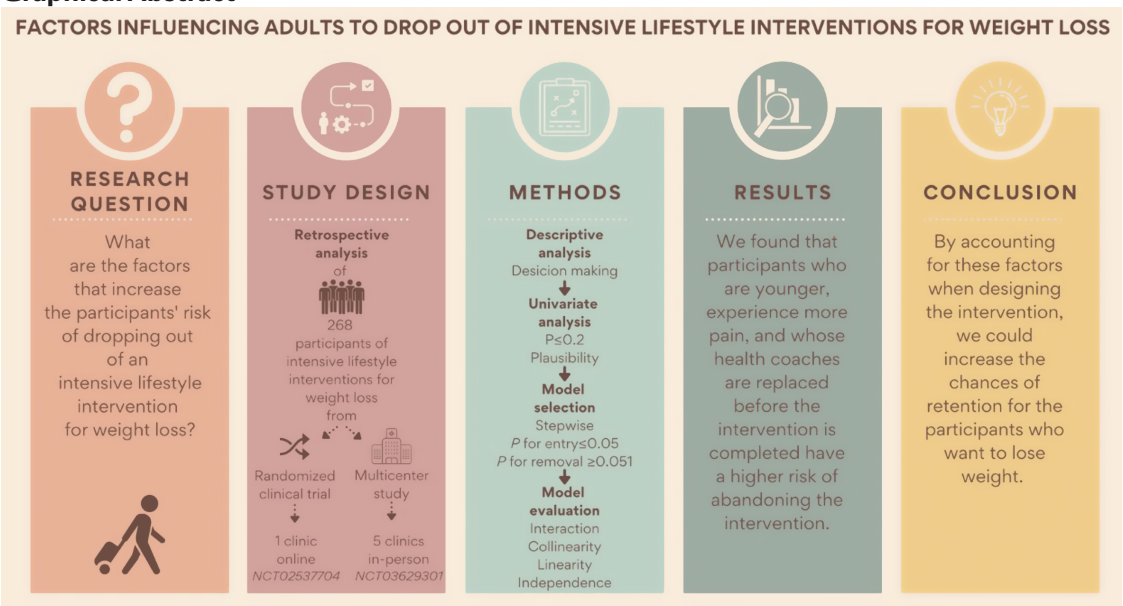
Reducing ≥5% of body weight can decrease the risk of developing chronic diseases in adults with excess weight. Although Intensive Lifestyle Interventions (ILIs) that include cognitive-behavioral techniques to improve physical activity and eating habits are the best approach for losing weight, the failure to retain participants is a barrier to their successful implementation. We aimed to investigate the factors influencing adults to drop out of ILIs for weight loss at six months. We conducted retrospective multiple logistic regression analysis of 268 participants with excess weight (body mass index ≥ 25 kg/m^2) from a multicenter study (n = 237, in-person ILI in five clinics, delivered by nutrition interns), and a randomized controlled trial (n = 31, one online ILI, delivered by a master's degree student). The same research team conducted both studies in Northern Mexico, using the same intervention components, and identical instruments and techniques to collect the data. We found that older participants (≥50 years) were less likely to drop out of the ILI for weight loss compared to participants <35 years old (OR = 0.34, 95% CI = 0.16–0.70). For each unit increase in the bodily pain scale of the SF-36 (less perceived pain), the risk of dropping out decreased by 2% (OR = 0.98, 95% CI = 0.97, 0.996), while a change in the interventionist during the 6-month intervention more than doubled the risk of dropping out (OR 2.25, 95% CI = 1.23–4.14). Retention in ILIs may be improved by ensuring that the same interventionist remains during the six-month intervention. In addition, ILIs may need further tailoring for younger ages and for participants with higher perceived pain.

Lay summary

Weight loss is hard. The best way to do it is to enroll in an intervention that includes frequent sessions with a health coach who uses cognitive-behavioral techniques to help participants improve their eating and physical activity habits. Retaining participants in these types of intervention is a challenge for health practitioners and researchers. Our objective was to identify the factors that increase the participants' risk of dropping out of the intervention. We analyzed the data of 268 Mexican adults who participated in studies that evaluated intensive lifestyle interventions for weight loss. We found that participants who are younger, experience more pain, and whose health coaches are replaced before the intervention is completed have a higher risk of dropping out of the intervention. By accounting for these factors when designing the intervention, we could increase the chances that participants stay in the intervention until the end. This way they are more likely to be successful in losing weight.

Keywords Dropout, Intensive lifestyle interventions, Retention, Weight loss

Graphical Abstract



Implications

Practice: Avoiding interventionist turnover and tailoring intensive lifestyle interventions for younger participants and those who experience more pain may reduce the risk of participants dropping out.
Policy: Policymakers who want to improve the implementation of intensive lifestyle interventions for weight loss should be informed about these barriers to completing the interventions.
Research: Future studies should test whether modifications to intensive lifestyle interventions to improve retention of younger participants and those who experience more pain are effective in reducing the risk of participants dropping out.

INTRODUCTION

Overweight and obesity (high body mass index (BMI), i.e., BMI ≥ 25 kg/m^2) are causes of a range of chronic conditions affecting the global population, including ischemic heart disease, stroke, diabetes mellitus, chronic kidney disease, hypertensive heart disease, low back pain, neurogenerative diseases and some cancers, such as breast, colorectal and endometrial cancer [1–4]. High BMI is now the fifth leading risk factor for death and disability across the globe [5], and the number of deaths and disability-adjusted life years lost attributable to high BMI have doubled since 1990 [1]. Initiatives aimed at reducing the population BMI may mitigate the burden of a wide range of diseases [1, 6], and reduce the strain it represents on the global health system [4]. International guidelines for obesity recommend frequent sessions delivered by a trained professional and a cognitive-behavioral approach for losing weight [7], as used in Intensive Lifestyle Interventions (ILIs), such as the Diabetes Prevention Program [8].

Although ILIs have proven to be effective for weight loss and the prevention of chronic diseases in adults with high BMI [6, 9, 10], and have been successfully translated to multiple settings [11, 12], one of the main barriers to their successful implementation is the failure to retain participants [13, 14]. A study that analyzed 41,203 participants enrolled in the in-person National Diabetes Prevention Program showed that almost 50% of the participants dropped out by week 26, and 68% by week 44 of the one-year program [13]. Moreover, just 19% of 12,966 participants from the online version completed 4 sessions or more [15]. This is also a problem in other epidemiological studies of ILIs for weight loss. According to systematic reviews of experimental and non-experimental studies, dropout can range from 0% to 46.8% for ILIs delivered in-person [16], and from 7.4% to 79.8% when delivered online [17]. The high dropout rate also limits our capacity to draw conclusions and generalize the results to other populations [18].

Most studies have focused on finding participant-related factors associated with an increased risk of dropout, such as full-time employment, living alone [19], depression [19–21], lower quality of life, decreased mental well-being [19], alcohol consumption [20], a younger age [13], fewer years of education [21], a higher binge eating score [21], higher blood pressure [20], and a higher [21] or lower BMI [19]. However, factors related to the intervention itself may also influence the risk of dropping out and are potentially modifiable to improve retention. For example, a greater travel distance to the clinic is associated with greater dropout [20], as well as the ability of the interventionist to develop meaningful relationships with or among participants [22]. It has also been suggested that using financial incentives [16], multicomponent interventions [23], and self-monitoring technology may enhance retention [23].

From a participant perspective, strong retention is critical because attendance at, and completion of, weight loss

interventions are associated with better weight loss outcomes [13]. Hence, identifying the factors that affect dropout can allow the development and implementation of strategies to increase retention in ILIs for weight loss. The aim of this study was to determine the factors affecting dropout among overweight adults participating in two ILIs for weight loss in Mexico.

Methods

Study design

The data analyzed were from the treatment groups of a multicenter study and a randomized clinical trial with a combined total of 268 participants [24, 25]. The two studies were conducted by the same research group and used the same intervention components. Multicenter data from 5 clinics where the face-to-face ILI was implemented in 2015-2016 were included (Figure 1): two were public primary healthcare clinics; two were public hospitals, and one was a university-based weight-loss clinic. Randomized controlled trial data from participants enrolled in the intervention arm of an online ILI conducted from April to October 2019 by a university-based weight loss clinic were included. This study is a secondary data analysis, and the experimental trials were not designed with this analysis pre-specified.

Sample

All participants were Mexican, overweight or obese (BMI ≥ 25 kg/m^2), aged between 18 and 65 years, and were either referred by their physician or enrolled voluntarily in the ILI. The majority of the participants were women (79.5%), with a mean BMI of 34.7 (SD 5.4) kg/m^2 and a mean age of 43.1 (SD 10.5) years (Table 1). Further information about the eligibility criteria can be found in the complete reports [24, 25].

Intervention

All clinics implemented and evaluated similar ILIs with cognitive-behavioral sessions, supplemented with individual nutritional counseling sessions for 6 months. The nutritional counseling sessions were conducted using similar procedures in both the randomized clinical trial and the multicenter study. The key difference was that, whereas the interventionist took participant measures for the in-person groups, those for the online group were self-reported. For both studies, all participants underwent a thorough nutritional examination that considered anthropometric, biochemical, dietetic, and clinical parameters before the initial session, which lasted between 40 and 60 minutes. The interventionist recommended a hypocaloric diet (1200–1800 kcal), with the option of a homemade or prepackaged meal replacement for breakfast or dinner, and monitored the participants' progress toward their goals in the subsequent 20–30 minute sessions.

The content and materials for the cognitive-behavioral sessions for both the in-person and online ILIs were almost identical during the intensive phase. The content for both versions was the Spanish translation of the Group Lifestyle Balance materials, with some adaptations to make them culturally appropriate, and two extra sessions based on the Mexican Equivalent Food System. For the less intensive phase (3.5–6 months) of the in-person intervention five of the original sessions were replaced with sessions on the prevention of cancer, diabetes, cardiovascular disease, and hypertension. The main differences in the online ILI compared to the in-person ILI were the digitalization of the reinforcement questionnaires using Google Forms, the online delivery format for the online version, and the lack of in-person dynamics.

The participants in the multicenter study (clinics 1-5) received 19 cognitive-behavioral sessions of 60-minutes each, adapted from the 2011 Group Lifestyle Balance materials [26]. The first 14 sessions were delivered weekly for the first three and a half months. In contrast, the nutritional counseling sessions ranged between 1 and 4 sessions per month, depending on the availability of the clinic. In practice, however, most clinics were able to offer weekly sessions. The timing for scheduling both group sessions and individual nutritional counseling sessions also relied on the availability

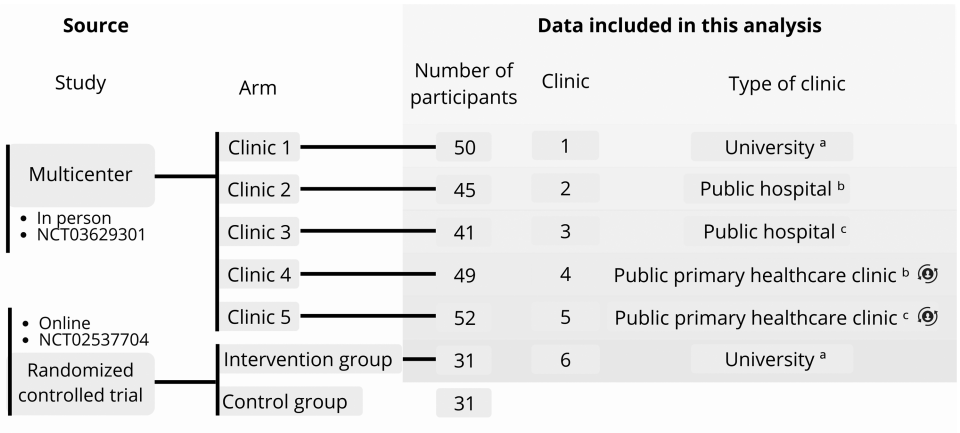


Figure 1 | Description of the characteristics of the two studies from which the data for 268 participants were extracted.

Table 1 | Descriptive characteristics of the study participants (n = 268)

Factors	Total (n=268)	Clinic 1 (n=50)	Clinic 2 (n=45)	Clinic 3 (n=41)	Clinic 4 (n=49)	Clinic 5 (n=52)	Online (n=31)	P-value*
					Mean (SD)			
Age, years	43.1 (10.5)	42.6 (11.4)	44.9 (9.3)	46.3 (8.2)	44.6 (10.2)	44.1 (9.9)	32.8 (8.5)	<0.05
BMI, kg/m²	34.7 (5.4)	34.7 (5.3)	35.0 (4.6)	34.6 (5.7)	35.1 (5.8)	35.0 (5.3)	33.0 (5.3)	0.65
					Prevalence (%) of participants			
Gender								0.68
Female	79.5	74.0	77.8	87.8	81.6	76.9	80.7	
Male	20.5	26.0	22.2	12.2	18.4	23.1	19.3	
Education Level								0.02
Elementary school or high school	49.6	46.0	71.1	46.3	59.2	42.3	25.8	
Bachelor's degree or postgraduate	50.4	54.0	28.9	53.7	40.8	57.7	74.2	
Marital status								<0.05
Married or cohabiting	37.1	40.0	24.4	24.4	44.9	31.3	64.5	
Single, divorced or widowed	62.9	60.0	75.6	75.6	55.1	68.7	35.5	
Monthly Income (MXN)								<0.05
<5,000	22.4	24.0	40.0	4.9	26.5	11.5	29.0	
$5,000 to $10,000	27.2	20.0	22.2	24.4	36.7	32.7	25.8	
$10,000 to <$20,000	33.2	30.0	15.6	51.2	28.6	38.5	38.7	
≥ $20,000	17.2	26.0	22.2	19.5	8.2	17.3	6.5	

MXN—Mexican pesos; BMI—body mass index.
* Chi-square test for comparison of categorical data between clinics or one-way ANOVA for comparison of continuous data between clinics.

of the nutritionist in the clinics. The complete list of sessions can be consulted in Armenta-Guirado et al. 2019 [24]. All intervention components were delivered in-person by a nutrition intern who lacked previous experience in obesity management but had received a 35-hour training course on the program and the clinical evaluation and management of obesity [24, 27]. The interventions started between September and October 2015 in all five clinics. However, other groups were opened between March and April 2016 in clinics 4 and 5 to complete the sample size. As the interventionists finished their social service in July and new interns began in August, the interventionists in these two groups changed midway through.

The participants in the randomized controlled trial (clinic 6) received 18 cognitive-behavioral sessions of 30-minutes each, adapted from the 2017 Group Lifestyle Balance materials [28]. The same subjects that were addressed in the multicenter study were covered in the intensive phase, including the sessions for the Mexican population. Group sessions were replaced by pre-recorded 10–15-minute-long videos (made by the research team) that the participants could watch when they had time. The Facebook messenger video call service was used to conduct the 1:1 nutrition counseling sessions, which were delivered weekly for the first 12 weeks and biweekly for the next 3 months, and had a duration of 30-minutes each. The sessions could be scheduled in the morning or afternoon, at a time convenient for the participant. All components of the online intervention were delivered by a master's degree student who is a dietitian with previous experience implementing the program in-person but not in the online setting [25]. All online participants started the intervention in April 2019.

Data collection

The same research team conducted the two studies, so the instruments and techniques used for collecting the data were identical. We had access to data related to the participants, such as baseline measurements and demographic characteristics, and information related to the interventions, such as the setting in which the intervention was delivered, and the type of clinic. All anthropometric measurements were conducted by a trained dietitian. BAG and TJMC conducted all measurements for the multicenter study, and TJMC conducted all measurements for the RCT. Further information on measurements can be consulted in Armenta-Guirado et al. 2019 [24]. The interventionist collected other participant-related variables, such as if they had tried to lose weight before or chose to use a meal replacement during the intervention. Additional data for this analysis was obtained from the registers of the clinics, such as their schedule availability for nutrition counseling and group sessions, information about the clinic infrastructure, and if the nutritionist that delivered the program was the same during the six-month intervention. Dropout was defined as not attending the six-month follow-up measurement.

Data analysis

Analyses were conducted in Stata/SE 14.2 for Mac. We used the multiple logistic regression method to determine the factors that affect the dropout rate in Mexican adults who participated in the ILI. Our outcome variable was dropout at six months (1 = yes, 0 = no). We first conducted an exploratory analysis to search for atypical values in the database, detect missing values, review the distribution of the variables, and assess the need to generate new variables. One-way ANOVA (alpha = 0.05, two-tailed) was used to assess differences in means across clinics and χ^2 tests to compare proportions across clinics at baseline. For the exploratory analysis, twenty-nine factors related to the participants and five related to the interventions that had been shown in previous studies

[19–21, 29–32] to be associated with the dropout rate or could potentially explain the dropout rate were considered (Table 2). Six of these (previous exercise, use of meal replacement, motivation for weight loss other than a medical referral, number of group sessions attended, and number of nutritional counseling sessions attended) could not be included in the multivariate analysis because the interventionists collected all of these variables, and we found that most participants who had dropped out had missing data.

We then conducted univariate logistic regression to assess the effect of participant and intervention characteristics on dropout. Variables were considered potential predictors of dropout for further testing in the multivariate analysis if they had a P-value ≤ 0.2 or showed biological plausibility. Variables were judged to be plausible if they had been shown in previous studies to predict dropout or there was a plausible explanation for how they could predict dropout. For the multivariate logistic regression analysis, we used the stepwise automatic method, starting with the full model and considering a P-value for entry of 0.05 and removal of 0.051. The significance of variables with three or more levels was tested using the testparm command in Stata, which is a Wald test.

Finally, we evaluated the obtained model. All variables were evaluated for interaction by assessing the statistical significance of interaction terms ($P \leq 0.05$). Collinearity was analyzed by regression diagnostics through a correlation matrix ($r < 0.80$). Independence was considered to hold due to the study design. Linearity was evaluated by generating a graph with the logarithm of the odds of dropout for continuous independent variables.

Odds ratios (OR) and 95% confidence interval for dropping out of the program were calculated for each independent variable. It was assumed that reference categories in the regression model had an OR of 1.0. A sensitivity analysis to assess if the differences in the study designs (RCT vs multicenter study) affected the results was conducted by repeating the whole process, excluding the online clinic.

RESULTS

Descriptive characteristics of the 268 participants can be found in Table 1. There were no significant differences in gender or body mass index at baseline between clinics. However, the participants from the online arm were younger and had a higher education level when compared to the other clinics. The main differences between clinics in the way that the intervention was delivered are illustrated in Figure 1. The majority of the participants received in-person ILIs, and most clinics only offered scheduling of nutritional counseling and group sessions in the morning.

In univariate analysis, sixteen factors met the plausibility criteria or had a P-value ≤ 0.2 (Table 3), and were therefore included in the multivariate analysis. Finally, 3 variables were obtained by the stepwise analysis: age, change in interventionist, and the 36-Item Short Form Health Survey (SF-36) bodily pain score. The model did not present interaction or collinearity. Linearity was met by the SF-36 bodily pain score, which was the only continuous variable included in the model. The SF-36 survey is an instrument that comprises 36 questions for evaluating 8 domains: physical functioning, role limitations due to physical problems, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and mental health. Each domain is given a score between 0 and 100; the greater the score, the better the perceived health status [33].This instrument has been validated in Mexico [34], and was used in both studies to evaluate changes in quality of life related to health [24, 25].

Table 2 | Factors considered as potential predictors of dropout from intensive lifestyle interventions

Participant related factors	
Anthropometric	Body fat percentage
	Body mass index
	Waist circumference
Biochemical	Cholesterol
	Glucose
	Triglycerides
Demographic	Age
	Has children
	Education level
	Income
	Marital status
	Sex
General health	Presence of a weight related disease
Mental health	Presence of depressive symptoms
Perceived health status (SF-36)	Bodily pain
	General health perceptions
	Health transition
	Mental health
	Physical functioning
	Role limitations due to emotional problems
	Role limitations due to physical problems
	Social functioning
	Vitality
Physical	Diastolic blood pressure
	Systolic blood pressure
Other	The participant exercised regularly before starting the program
	The participant had a motivation for weight loss other than a medical referral
	The participant had attempted to lose weight prior to the intervention
	Number of group sessions attended
	Use of meal replacement
Intervention related factors	
Infrastructure	Multiple consultations could be occurring in the same space
Unexpected changes during the intervention	Change in schedule for group sessions
	Change in interventionist
Healthcare service delivery	Schedule availability for nutritional counselling sessions (morning and/or afternoon appointments available)
	Schedule availability for group sessions (morning and/or afternoon appointments available)

SF-36 - 36-Item Short Form Health Survey.
All participant related factors were measured at baseline, except for "Number of group sessions attended".

Table 3 | Factors that affect dropout at 6 months in univariate analysis

Factors	Completers (n=150)	Dropped out (n=118)	P-value	Unadjusted odds ratio for dropping out (95% CI)
	Prevalence (%) of participants			
Age [<35 years]	20.0	31.4	0.03	1.00
35 to <50 years	48.7	49.1		0.64 (0.36 to 1.16)
≥ 50 years	31.3	19.5		0.40 (0.20 to 0.79)
Education Level [Elementary school or high school]	51.1	54.8	0.57	1.00
Bachelor's degree or postgraduate	48.9	45.2		0.86 (0.57 to 1.44)
Has children [No]	17.4	21.9	0.36	1.00
Yes	82.6	78.1		0.75 (0.41 to 1.39)
Marital status [Single, divorced or widow]	36.7	37.7		1.00
Married or cohabitation	63.3	62.3		0.96 (0.58 to 1.58)
Depressive symptoms [Absence of symptoms]	53.3	50.0	0.59	1.00
Presence of symptoms	46.7	50.0		1.14 (0.71 to 1.85)
Income (MXN) [<$5,000]	24.0	20.3	0.23	1.00
$5,000 to $10,000	26.7	28.0		1.24 (0.62 to 2.47)
$10,000 to <$20,000	31.3	35.6		1.34 (0.69 to 2.60)
≥$30,000	18.0	16.1		1.06 (0.48 to 2.31)
Change in interventionist [No]	84.7	70.3	<0.01	1.00
Yes	15.3	29.7		2.33 (1.29 to 4.22)
Schedule availability for group sessions [Morning]	51.3	58.5	0.41	1.00
Afternoon	37.3	29.7		0.70 (0.41 to 1.19)
Morning and afternoon	11.3	11.9		0.92 (0.42 to 2.00)
Schedule availability for nutritional counselling [Morning]	65.3	75.4	0.07	1.00
Morning and afternoon	34.7	24.6		0.61 (0.36 to 1.05)
Change in schedule for group sessions [No]	65.3	58.5	0.25	1.00
Yes	34.7	41.5		1.34 (0.81 to 2.20)
Type of clinics [University]	34.7	24.6	0.075	1.00
Public	65.3	75.4		1.63 (0.95, 2.78)
	Mean (SD)			
Relative fat mass index (%)	44.0 (7.0)	45.0 (7.0)	0.24	1.02 (0.99, 1.06)
Physical functioning (score)	77.4 (16.7)	74.6 (19.7)	0.20	0.99 (0.98, 1.00)
Role limitations due to physical problems (score)	66.3 (37.2)	59.1 (39.6)	0.13	0.99 (0.99 to 1.00)
Bodily pain (score)*	72.8 (21.6)	66.0 (24.0)	0.02	0.98 (0.98 to 1.00)
General health (score)	60.4(17.6)	57.4 (19.4)	0.17	0.99 (0.98 to 1.00)

CI—confidence interval; MXN—Mexican pesos.
†Reference category in square brackets.
*SF-36 bodily pain subscale score: a higher score means lower perceived pain.

The model, shown in Table 4, includes the factors age, change in interventionist, which describes whether the nutritionist delivering the intervention changed during the program, and pain, measured from the SF-36 bodily pain score. The exclusion of the online clinic as a sensitivity analysis resulted in a model with the same variables and minimal impact on the odds ratios. Thus, we feel confident about including it in the analysis (Table 4).

The participants older than 50 years of age had a 66% greater chance of staying in the intervention than the participants younger than 35 years of age (OR = 0.34, 95% CI = 0.16–0.70). Also, a tendency toward greater retention was observed in the category between 35 and 50 years old, but this was not significant. Participants had 2.25 times greater chance of abandoning the intervention when their interventionist was changed during the intervention (OR = 2.25, 95% CI = 1.23–4.14). Participants who experienced less pain (higher scores on the bodily pain scale of the SF-36) had a slightly lower chance of dropping out of the intervention. For each unit increase in the bodily pain score (less pain), the risk of dropping out of the intervention decreased by 2% (OR = 0.98, 95% CI = 0.97–0.996). Although the effect found by this study may seem clinically small when assessed per unit increase in pain score, the standard deviation for bodily pain was large (SD = 22.8). Thus, for each 1 SD increase in the pain score (22.8 units), the participant had 30% lower chance of dropping out of the intervention (OR = 0.70, 95% CI = 0.62–0.78). This shows how important it is to identify those with higher levels of pain (lower scores).

Table 4 | Factors that affect dropout at 6 months

	All clinics (n=268)		Clinics from multicenter study (n=237)	
Factors	**Adjusted odds ratio for dropping out (95% CI)**	**P-value**	**Adjusted odds ratio for dropping out (95% CI)**	**P-value**
Age [<35 years]				
35 to <50 years	0.56 (0.30 to 1.05)	0.071	0.52 (0.25 to 1.08)	0.082
≥ 50 years	0.34 (0.16 to 0.70)	0.004	0.33 (0.15 to 0.74)	0.007
Change in interventionist [No]				
Yes	2.25 (1.23 to 4.14)	0.009	2.23 (1.20 to 4.16)	0.012
Bodily pain (score)*	0.984 (0.97 to 0.996)	0.007	0.985 (0.97 to 0.997)	0.016

CI—confidence interval.
†Reference category in brackets.
*SF-36 bodily pain subscale score: a higher score means lower perceived pain.

DISCUSSION

The analysis presented in this paper shows that, in a sample of Mexican adults participating in an ILI, younger age, changing the interventionist during the intervention, and a greater perceived bodily pain felt by the participant increased the risk of dropping out.

Age

Younger age has been consistently reported in other studies to increase the risk of dropping out of ILIs [20, 21]. Participants aged 50 years or above are more likely to adhere to dietary treatments [35], and tend to do more activities linked with the success of the program [36]. This may be due to a greater risk perception, probably due to the emergence of health problems that are more likely to appear with increasing age. Some studies have highlighted the importance of tailoring ILIs to retain younger participants [13, 15, 37], and technology-driven interventions were developed for this purpose. However, studies have shown that older participants still obtain better results compared to younger participants, even in online settings [31, 37].

Change in interventionist

Interventionists, often called coaches, facilitators, or lifestyle coaches, among other terms, are an essential part of the implementation of ILIs. They need time to familiarize themselves with the curriculum, make the adaptations for the particular population they are intervening in, and to involve and motivate the participants [38]. If they are changed before the end of the 6 months, the time may not be enough for them to develop the required competencies, or meaningful relationships with or among participants [22], causing participants to be more susceptible to dropping out.

All interventionists in the multicenter study were nutrition interns studying the last semester of a 4-year nutrition degree, and their supervisors, BAG and TJMC, were dietitians and master's degree students [24]. The interventionist from the randomized controlled trial was a dietitian and master's degree student who transitioned to a PhD mid-way during the intervention (ALR). It is important to note that all interventionists achieved significant results in terms of their participants' weight loss. However, those who replaced another interventionist achieved a lower retention rate among their participants compared to those who started from the beginning (39.7% vs 60.5%). Thus, retaining the interventionist is crucial to retaining participants. Hence, if ILIs are to be delivered by interns, their time availability needs to be considered at the time of recruitment to ensure that they can continue for the duration of the intervention. If ILIs are to be delivered by registered dietitians, it is also important to prevent turnover. According to Hewko et al. [39], some strategies that can be used to retain registered dietitians are to ensure that they have a good system of manager support and growth opportunities, as well as strategies to prevent burnout, to manage tension/conflict between staff, and to plan reasonable hours of work.

Pain

The effect of pain on the risk of dropping out has been previously reported in a study that evaluated an ILI adapted from the Diabetes Prevention Program and conducted in American Indian and Alaskan Native populations, where more baseline chronic pain measured with a visual scale was associated with a higher risk of dropping out [37]. Obesity and pain often occur together in a complex relationship in which each condition can worsen the other [40]. Those who suffer obesity and pain often deal with health problems that can hinder their efforts to adopt healthy habits, such as disturbed sleep, depression, osteoarthritis, increased systemic inflammation, more fear of movement, and a higher physical effort under a comparable workload relative to normal-weight people [41]. In addition, a survey-based study conducted in Australian adults with excess weight showed that participants with chronic pain do not perceive diet as helpful for improving their pain, despite the benefits [42].

Cooper et al. [43] state that healthcare professionals interacting with adults with both excess weight and pain should understand the physical and psychological effects of pain that make healthy behavior more challenging, and develop appropriate programs that combine both aspects (weight and pain) to promote better outcomes in terms of weight loss and pain reduction. Strategies that teach patients how pain works from a biological and physiological perspective, such as pain neuroscience education,

have been shown to decrease pain [44], and could be easily included in ILIs. Those who experience pain are interested in their condition [44]. Thus, by addressing their pain and providing evidence-based resources to improve it, we could increase their interest in the ILI and reduce their risk of dropping out.

How we can increase retention

Previous studies suggest that high retention ILIs are more likely to provide incentives for participating, use credible sources (which is where the intervention is delivered by a credible spokesperson, such as a healthcare professional), instruct the participants how to perform a behavior, use problem-solving, social support strategies, and techniques to reduce negative emotions [16]. In addition, focusing on changing behaviors, such as minutes of physical activity or number of fruit and vegetables consumed, rather than weight may help to improve retention [16]. The timing is also important: the most vulnerable stages for the participants to dropout from ILIs are after the first week and during the transition from the intensive to the follow-up phase [13]. Some suggested strategies to overcome this include scheduling the session that covers techniques to reduce negative emotions early in the intervention or organizing social gatherings to create a bond among the participants to promote social support.

Although providing a flexible schedule has only been reported as helpful in qualitative studies [29], and that it may be hard to apply in real-world settings, asking both the participants and the interventionist their availability before implementation could be an easy way to potentially improve retention.

Considerations for future research

Among the most mentioned reasons given by the participants for dropping out, was the inability to commit to the intervention schedule and time constraints [16]. Other related factors that may negatively impact retention are preventing classes from being scheduled at flexible times, in a suitable location [29], and with flexibility for making changes to the schedule [45]. We evaluated three related variables (schedule availability for group sessions, schedule availability for nutritional counseling sessions, and change in schedule for group sessions), and even though they were not included in the final model, they met the criteria for being included in the univariate analysis. Thus, we suggest that future studies should further investigate how these types of variables impact retention, if their effects are meaningful for public health application, and how we can improve interventions through their modification.

Future high-quality studies are also necessary to assess the role of other interventionist-related factors on dropout, such as level of training, turnover, and the modifications made to the program for different settings [22].

Strengths and limitations

The strengths of this study include the fact that both studies were conducted by the same research team, using mostly the same intervention materials, and the use of consistent instruments and techniques for data collection. However, the analysis did have several limitations. First, we did not have information about important variables that have been shown previously to be associated with an increased risk of dropping out, such as the week in which the participants dropped out of the intervention and why they dropped out. It has been documented that dropout rates are higher during the second week and during the transition from weekly to monthly sessions [13]. It is important to understand why participants drop out at this time to allow testing of the effect of modifications to the intervention in the risky weeks. Second, we had a substantial amount of missing data from most non-completers for other important variables, such as if they had attempted to lose weight or had undertaken physical activity [21]. These variables were collected by the interventionists (nutrition interns) in the multicenter study, and their lack of data collection ability or time available may have been a barrier [22]. We suggest that future research should include important variables in the baseline measurements conducted by the staff, and the study team should provide training for all interventionists in how to collect data. Another limitation was the small sample for the online intervention in comparison to the other five in-person arms. However, our sensitivity analysis showed that removing the online clinic did not have an important impact on the results and conclusions.

CONCLUSION

Intensive lifestyle interventions are an effective strategy for promoting healthy eating and physical activity habits, and to reduce the population prevalence of overweight and obesity. However, we know that many participants do not complete the intervention. Strong retention is essential for the success of these programs, since participation in and completion of weight loss programs are linked to greater weight reduction. The results of this study suggest that it may be possible to improve retention of participants through the design of the intervention. Maintaining the same interventionist over the course of the six months could help to retain the participants in ILIs and enhance their overall impact on weight loss. Additionally, ILIs could be further tailored to improve the retention of younger participants and of those who experience more pain.

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Compliance with Ethical Standards

Conflict of Interest: None declared.

Primary Data: Findings reported have not been previously published and this manuscript is not being simultaneously submitted elsewhere. Data have not been previously reported elsewhere. The authors have full control of all primary data and agree to allow the Journal to review data if requested.

Ethical Approval: All procedures performed in studies involving human participants were in accordance with the

ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed Consent: Informed consent was obtained from all individual participants included in the study.

Transparency statements Study registration

This study was not formally registered. The two studies from which the data were extracted were pre-registered at clinicaltrials.gov (https://clinicaltrials.gov/ct2/show/NCT02537704 and https://www.clinicaltrials.gov/ct2/show/NCT03629301).

Analytic plan registration

The analysis plan was not formally pre-registered.

Availability of data

De-identified data from this study are not available in a public archive. De-identified data from this study will be made available (as allowable according to institutional IRB standards) by emailing the corresponding author.

Availability of analytic code

Analytic codes used to conduct the analyses presented in this study are not available in a public archive. They may be available by emailing the corresponding author.

Availability of materials

Materials used to conduct the study are not publically available.

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