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ORIGINAL PAPER

Exploring the Role of Depression as a Moderator of a Workplace Obesity Intervention for Latino Immigrant Farmworkers

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Abstract

We explored if and how depression moderated the treatment effect of *Pasos Saludables*, a successful pilot workplace obesity intervention for Latino immigrant farmworkers. The original randomized controlled study assigned 254 participants 2:1 to a 10-session educational intervention versus control. We assessed the relationship between change in BMI (primary outcome) and interaction of treatment allocation and baseline risk for depression. Baseline CES-D scores indicated that 27.3% of participants were at risk for depression. The interaction between treatment allocation and baseline risk for depression was significant ($p = 0.004$). In adjusted models among women, intervention participants with no indication of depression at baseline reduced their BMI by 0.77 on average (95% CI − 1.25, − 0.30) compared to controls. The reduction im BMI between the intervention group at risk for depression at baseline and either control was not significantly different from zero. Findings from our post-hoc, exploratory study indicate that depression may inhibit significant weight loss.

Keywords Migrant farmworkers · Latino immigrants · Obesity · Mental health · Intervention

Introduction

Farmworkers in the United States (US)—75% of whom are Latino immigrants [1]—face high rates of obesity and overweight and are at increased risk for diabetes and cardiovascular disease (CVD) [2–8]. In general, Latino immigrants are less likely to be overweight or obese than US-born Latinos [9–11]. While immigrant farmworkers also experience this "healthy immigrant paradox" for some health indicators, [12] this does not appear to be the case in the area of obesity. Studies across the US indicate that over 70% of farmworkers are overweight or obese, 30–65% are obese [2–6], and they experience an elevated prevalence (26–39%) of diabetes mellitus type 2 (DM II) [7]. In spite of the harsh physicality of farm work, some functions of the job imply a higher or lower cardiovascular exertion rate than others, so for some a high level of cardiovascular exertion is not necessarily maintained throughout the workday [13]. Compared to other occupations, farm work is associated with a higher risk of metabolic syndrome [8], and over 56% of farmworkers met the criteria for this syndrome in a study along the Southwest border [3].

Structural barriers, such as poverty, undocumented status, and lack of access to healthcare are exacerbated among immigrant farmworkers [3, 14–18]. In addition, farmworkers confront rural isolation and poor/unsafe working and living conditions [19–23]. High levels of food insecurity, in particular reduced access to nutritious meals—which have been linked to increased prevalence of obesity [24, 25]—are also observed among farmworkers [3, 26]. All these factors may help explain how disparities in obesity, diabetes, and metabolic syndrome persist and speak to the need for interventions that attend to the specific risks and social determinants immigrant farmworkers face. Along with social marginalization and disproportionate rates of obesity, immigrant farmworkers manifest high levels of depressive symptoms [2, 3, 14, 16, 27–32]. Across varied contexts and geographies,

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anywhere from 20% to nearly 50% of immigrant farmworkers report symptoms that could indicate clinical depression [14, 16, 27–31], compared to only 7.6% of adults in the US overall and 9.4% of Latino adults [33].

Much evidence exists on the contribution of biological, lifestyle, structural, and environmental factors in the increasing prevalence of overweight/obesity [34]. The role of psychosocial factors—such as depression—is less well understood. Clinical depression may lead to weight loss in some individuals and weight gain in others, and a reverse relationship between obesity and depression has been documented [35–37]. Understanding this link is important in order to design effective interventions that facilitate adoption of healthy behaviors and target individuals who stand to benefit the most from these interventions. Intervention research provides a distinct ability to better understand the role of psychosocial factors in preventing and/or reducing overweight and obesity. For example, substantial evidence points to high stress—without active coping strategies—as a predictor of weight gain over time among individuals who have achieved significant weight loss [38–41].

Lifestyle interventions require individuals to make significant changes in their daily lives [42], and psychosocial factors may influence one's ability to adopt these behaviors [39, 41]. If intervention participants are experiencing significant depressive symptoms—as appears to be the case among many immigrant farmworkers who face heightened structural vulnerabilities—their ability to make and maintain these changes could be inhibited [36]. Identifying moderators of treatment effects can help lead to a better understanding of under what circumstances and for whom interventions are more or less effective [43].

Most farmworkers in the US are Latino immigrants, and despite disparities in rates of obesity and depression, few interventions outside of safety/injury prevention have targeted immigrant farmworkers. We use data from *Pasos Saludables*, the only obesity intervention designed specifically for Latino immigrant farmworkers, to jointly explore both areas of health. Our purpose is to explore if and how depressive symptoms moderate the treatment effect of this promising intervention [6]. In the original study, female intervention participants experienced a significant decrease in BMI compared to the control, but no significant differences in depressive symptoms between baseline and follow-up were detected [6].

Methods

The data originated from *Pasos Saludables* (Healthy Steps), a randomized, controlled pilot intervention, whose objective was to reduce obesity within an immigrant farmworker population. The study is described in detail in Mitchell et al. [6] and is registered with https://ClinicalTrials.gov (NCT01855282). The University Institutional Review Board approved the study.

Participants

The intervention was implemented at two California berry grower worksites (Watsonville and Oxnard) between April 2010 and January 2011. To be included in the study, workers needed to be between 18 and 60 years of age with a BMI between 20 and 38 kg/m^2, hold health insurance (a requirement from the grower/study sponsor), expect to remain in the area for at least 6 months, express willingness to attend the 10 weekly sessions, and have a basic ability to speak and read Spanish. Exclusion conditions included diabetes, pregnancy, trying to conceive, breastfeeding, on medication or diets that affect weight, or a medical condition that prohibited physical activity. Finally, only one participant per household was enrolled. All participants provided written consent.

Blind Randomization

A 2:1 ratio and digital random number generator was used to assign participants to the intervention or the control; the control received no information on diet or physical activity. A field coordinator informed participants of their allocation. Bilingual Latina research assistants, who were blinded to assignment, conducted the screening, baseline, and follow-up assessments, and all communication with participants.

Intervention

The pilot intervention, which is currently being implemented on a larger scale, was modeled in part after the "Your Heart, Your Life" Latino obesity reduction program [44] that is designed to be more accessible to lower literacy groups. Bilingual Latina *promotoras* conducted the weekly sessions. The program was designed with participants as active agents in the process and centered on *Cinco Pasos para Vivir Mejor* (five steps to Live Better) from a Mexican government social media campaign: (1) drink water, (2) eat fruits and vegetables, (3) measure (what you eat and your waist), (4) move, and (5) share (the message) [45]. Sessions included education components, moderate physical activity, and discussion related to weekly goals ("promises") participants shared with the group at the end of each session. See Mitchell et al. for further details on the intervention [6].

Data Collection

Baseline assessment was conducted pre-randomization and included anthropometric measurements and a survey

interview administered in Spanish by a research assistant [6]. Follow-up assessment occurred between 12 and 14 weeks from baseline, 2–3 weeks after the intervention sessions concluded. Intervention participants attending three or more sessions and completing the follow-up assessment were considered "completes." Control participants only had to complete the follow-up assessment to be considered completes.

Measures and Outcomes

The primary outcome for the intervention was change in BMI (follow-up BMI minus baseline BMI).

Risk for depression at baseline was assessed with the Center for Epidemiological Studies-Depression (CES-D)-10 [46]. Participants indicated the frequency that they experienced ten depressive symptoms in the past week (rarely or never [< 1 day], sometimes or a few times [1–2 days], occasionally/moderate amount of time [3–4 days], or majority of the time [5–7 days]) (scale range 0–30). The CES-D-10 has been validated in Latino immigrant (farmworker) populations [47] and had high internal consistency with our sample (Cronbach alpha 82.5%). A dichotomous variable was created following the suggested cutoff that scores of 10 or higher are indicative of clinical depression, in line with the Grzywacz et al. study that validated use of the CES-D-10 in Latino immigrant (farmworker) populations [47, 48].

Additional administrative and demographic characteristics included site, study completion, age, gender, number hours worked, years in US, education, family income, and marital status.

Analysis

Mitchell et al. [6] describe the intervention's main effects. This post-hoc exploratory analysis assesses moderation of treatment effect by examining the interaction between baseline risk for depression and treatment allocation. We first compared the distribution of risk for depression between control and intervention groups. We then compared baseline characteristics of control versus intervention within the baseline risk for depression and no baseline risk for depression groups to assess whether there were any important, observable differences within these strata. Chi square (or Fisher's exact test where expected cell sizes were < 5) and two-sample t-tests were used as appropriate.

We then estimated the treatment effect (change in BMI for treatment vs. control) within groups stratified by depression risk. We also compared the change in BMI for the intervention group at high risk for depression versus the control with no baseline risk for depression. Unadjusted and adjusted (age, gender, and baseline BMI) multiple linear regression models assessed the relationship between change in BMI and the interaction of treatment allocation and baseline risk for depression. The margins command in Stata was used to estimate adjusted changes in BMI. Because the original study analyzed women and men separately and a significant treatment effect was found among females alone [6], we also ran models separately for women. Data were analyzed using Stata 14.0 [49].

Sensitivity Analyses

Overall, the difference in follow-up between the intervention and control was large and statistically significant. Sixty-six out of 80 control participants (82.5%) completed the study, compared to 64.4% of intervention participants (112 of 174) ($p = 0.003$). This difference in completion was also observed among those who exhibited no risk for depression at baseline (82.5% of control participants vs. 62.2% of intervention participants, $p < 0.001$), but there was no difference in completion among those at risk for depression. Because we are not able to observe what happens to a large proportion of those in the group with no indication of clinical depression, our estimates could be biased. Any effect we find could be an artifact of differential loss-to-follow-up as opposed to an actual moderating effect. To assess the potential bias, we used multiple imputation [50] to conduct sensitivity analyses modeling hypothetical outcomes for participants who were lost to follow-up under various scenarios (see Online Appendix).

Results

Participant Characteristics

Of the 254 participants, 174 were assigned to the intervention and 80 were assigned to the control (Fig. 1). Most intervention completes attended 8–10 sessions (78%, see Mitchell et al. [6]), and the remaining attended between three and seven sessions.

A total of 27.3% of participants scored ≥ 10 on the baseline CES-D-10 assessment, indicating high risk for depression (Table 1). One intervention participant who did not complete the program also had missing values for baseline CES-D-10. There was no difference in the distribution of risk for depression between intervention and control; this was true among all participants (26.6% of intervention vs. 28.8% of control, $p = 0.720$) or only those who completed (29.7% of intervention vs. 28.8% of control, $p = 0.924$).

When stratified by baseline depression risk, there were no differences between intervention and control groups by gender, age, number of hours worked, years in US, education, income, or marital status (Table 2). However, there were differences in baseline BMI among those with baseline risk for depression (and overall as reported in Mitchell et al. [6]) at the 90%

Fig. 1 CONSORT diagram

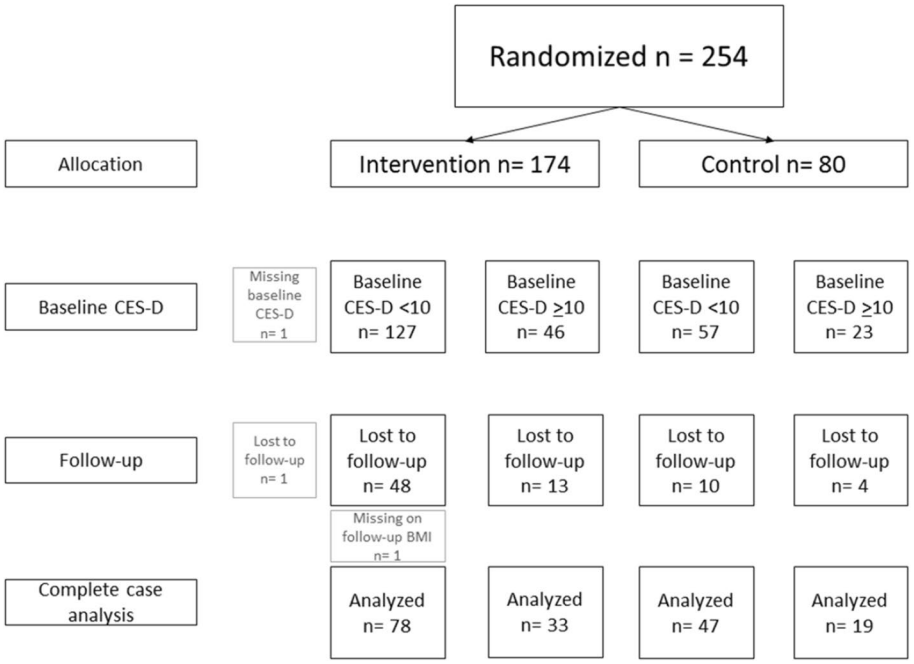

Table 1 Baseline CES-D by treatment group

	All participants			*p*	Among completed			*p*
	Control (n = 80)	Intervention (n = 173)	Total (n = 253)		Control (n = 66)	Intervention (N = 111)	Total (n = 177)	
Mean (SD), range								
CES-D	7.0 (5.6), [0–22]	7.2 (6.1), [0–33]	7.2 (6.0), [0–30]		7.1 (5.6), [0–22]	7.5 (6.3), [0–30]	7.4 (6.0), [0–30]	
%								
CES-D < 10	71.2	73.4	72.7	0.720	71.2	70.3	70.6	0.924
CES-D ≥ 10	28.8	26.6	27.3		28.8	29.7	29.4	
Total	100.0	100.0	100.0		100.0	100.0	100.0	

significance level. On a whole, intervention participants had a BMI of over one unit higher than control participants.

Overall, completion rates did not differ by baseline depression status (75.4% for those with baseline risk for depression versus 68.5% for those with no baseline risk, p = 0.286). There were also no detectable differences in completion by treatment among those with baseline risk for depression (82.6% control vs. 71.7% intervention, p = 0.323). However, as mentioned above, completion rates were significantly different for those with no indication of depression at baseline (82.5% for control vs. 62.2% for intervention, p = 0.006).

Baseline Depression as Moderator of Treatment Effect

Overall, intervention participants saw a 0.63 average reduction in BMI from baseline to follow-up at 12–14 weeks (95% CI − 0.96, − 0.29) compared to the control in adjusted models (Table 3). Among women, there was an average reduction in BMI of 0.64 for intervention compared to control participants (95% CI − 1.04, − 0.24).

The interaction between the treatment variable and baseline risk for depression was significant (p = 0.004). In adjusted models, the intervention group with no indication of depression at baseline significantly reduced their BMI by 0.72 on average (95% CI − 1.12, − 0.32) compared to controls (Table 3; Fig. 2). The reduction observed within the group at risk for depression was not significantly different from zero (0.40 reduction compared to controls at risk for depression, [95% CI − 1.02, 0.22]). However, when compared to the control group with no baseline risk for depression, the reduction (− 0.60 [95% CI − 1.09, − 0.11]) was significant. Finally, women with no risk for depression at baseline significantly reduced their BMI (0.77; 95% CI − 1.25,− 0.30). Conversely, no significant effect was detected

Table 2 Baseline demographic and study data by depressive symptoms and treatment group

Study arm (*N*)	CES-D < 10				CES-D ≥ 10			
	Control (57)	Intervention (127)	Total (184)	*p*	Control (23)	Intervention (46)	Total (69)	*p*
N (%)								
Site—Watsonville	22 (38.6%)	53 (41.7%)	75 (40.8%)	0.689	8 (34.8%)	20 (43.5%)	28 (40.6%)	0.488
Female	41 (71.9%)	87 (68.5%)	128 (69.6%)	0.640	18 (78.3%)	37 (80.4%)	55 (79.7%)	0.832
Mean (SD)								
Age	32.5 (8.2)	32.7 (7.7)	32.6 (7.8)	0.898	32.4 (7.2)	31.3 (7.3)	31.7 (7.3)	0.556
BMI	27.4 (4.1)	28.6 (4.2)	28.2 (4.2)	0.085	26.4 (3.6)	27.9 (3.4)	27.4 (3.5)	0.113
Hours worked	46.3 (13.5)	48.1 (13.5)	47.6 (12.0)	0.336	45.0 (10.4)	48.2 (13.1)	47.2 (12.3)	0.319
Years in US	11.8 (6.6)	11.7 (6.3)	11.8 (6.3)	0.975	9.9 (5.4)	11.2 (6.1)	10.7 (5.9)	0.389
N (%)								
Education level				0.696				0.200
Up to grade 6	30 (52.6%)	62 (48.8%)	92 (50.0%)		17 (73.9%)	26 (56.5%)	43 (62.3%)	
Grade 7–9	18 (31.6%)	36 (28.4%)	54 (29.4%)		3 (13.0%)	13 (28.3%)	16 (23.2%)	
Grade 10 to college	8 (14.0%)	22 (17.3%)	30 (16.3%)		2 (8.7%)	7 (15.2%)	9 (13.0%)	
Missing	1 (1.8%)	7 (5.5%)	8 (4.4%)		1 (4.4%)	0	1 (1.5%)	
Family income				0.134				0.153
< $10,000	6 (10.5%)	27 (21.3%)	33 (17.9%)		5 (21.7%)	13 (28.3%)	18 (26.1%)	
$10,001–$20,000	24 (42.1%)	34 (26.8%)	58 (31.5%)		14 (60.9%)	17 (37.0%)	31 (44.9%)	
> $20,000	24 (42.1%)	59 (46.5%)	83 (45.1%)		4 (17.4%)	16 (34.8%)	20 (29.0%)	
Missing	3 (5.3%)	7 (5.5%)	10 (5.4%)		0	0	0	
Marital status				0.844				0.769
Married/married-like	45 (79.0%)	102 (80.3%)	147 (79.9%)		16 (69.6%)	32 (69.6%)	48 (69.6%)	
Other	12 (21.0%)	25 (19.7%)	37 (20.1%)		7 (30.4%)	13 (28.3%)	20 (29.0%)	
Missing	0	0	0		0	1 (2.2%)	1 (1.5%)	

for intervention women with baseline risk for depression compared to either control—the control with baseline risk for depression (0.36 reduction in BMI; 95% CI − 1.07, 0.34) or the control without (0.52 [95% CI − 1.08, 0.03]).

Sensitivity Analyses

Results from the sensitivity analyses are presented in the supplementary appendix; the direction and significance of estimates were consistent with findings from the complete case analysis presented above, although the magnitude of the estimated change in BMI for the intervention compared to the control in each condition was slightly lessened at each step. One notable difference for the analyses that included all participants (i.e., women and men) was observed in the most conservative model, which penalized values of the predicted change in BMI for intervention participants lost to follow-up only. Under that scenario, the treatment effect for those at risk for depression at baseline was not significant either within this stratum or compared to the control with no baseline risk for depression (Table A2 in Online Appendix). Findings for analyses among women alone were again consistent with complete case analyses.

Discussion

Findings from our post-hoc, exploratory study indicate the potential for baseline depression to act as a treatment effect modifier in a workplace obesity intervention for Latino immigrant farmworkers. This was the case among women where the treatment effect for intervention participants at baseline risk for depression was not significant compared to either control, in complete-case and all sensitivity analyses. Because the presence of depression may at once contribute to obesity and be exacerbated by the state of being overweight or obese, interventions must recognize and attend to this bidirectional link. This is especially the case for interventions among immigrant farmworkers, as obesity and mental health are two of the most pressing issues facing this population [51]. Even under optimal circumstances, it is challenging to make the substantial lifestyle and behavior changes required for sustained weight loss over time. Under strained mental health and limited coping resources, this process can be even more arduous. The lives of immigrant farmworkers are marked by numerous structural vulnerabilities that likely contribute to chronic stress and heightened rates of depression [14, 16]. Efforts to mitigate these factors, combined with efforts to

Table 3 Unadjusted and adjusted change in BMI (follow-up BMI minus baseline BMI) by treatment and baseline depressive status

	Unadjusted change in BMI Mean (95% CI)		Adjusted change in BMI Mean (95% CI)			
	Control	Intervention	Control	Intervention	Difference (treatment effect)	
Complete case analysis (n = 177)						
All	0.334 (0.075, 0.597)	−0.293 (−0.495, −0.092)	0.335 (0.069, 0.600)	−0.293 (−0.496, 0.089)	Intervention versus control −0.63 (−0.96, −0.29)	
CES−D < 10	0.394 (0.084, 0.705)	−0.322 (−0.563, −0.081)	0.393 (0.079, 0.706)	−0.330 (−0.576, −0.083)	CES-D < 10 intervention versus CES-D < 10 control −0.72 (−1.12, −0.32)	
CES-D ≥ 10	0.191 (−0.297, 0.680)	−0.223 (−.596, 0.145)	0.193 (−.302, 0.688)	−0.205 (−0.580, 0.170)	CES-D ≥ 10 intervention versus CES-D ≥ 10 control −0.40 (−1.02, 0.22)	CES-D ≥ 10 intervention versus CES-D < 10 control −0.60 (−1.09, −0.11)
Among women (n = 135)						
All	0.330 (0.025, 0.635)	−0.363 (− 0.600, −0.125)	0.300 (− 0.014, 0.607)	−0.343 (− 0.583, −0.102)	Intervention versus control −0.64 (−1.04, −0.24)	
CES-D < 10	0.370 (0.007, 0.734)	−0.456 (−0.747, −0.164)	0.345 (−0.023, 0.713)	−0.428 (−0.725, −0.131)	CES-D < 10 intervention versus CES-D < 10 control −0.77 (−1.25, −0.30)	
CES-D ≥ 10	0.233 (−0.331, 0.796)	−0.177 (−0.589, 0.235)	0.187 (− 0.0383, 0.759)	−0.176 (−0.591, 0.239)	CES-D ≥ 10 intervention versus CES-D ≥ 10 control −0.36 (−1.07, 0.34)	CES-D ≥ 10 intervention versus CES-D < 10 control −0.52 (−1.08, 0.03)

Adjusted estimates are adjusted for age, sex, and baseline BMI

increase access to mental health services could improve both mental and physical health.

To achieve success, interventions must attend to the reality of the circumstances facing participants. Rates of depression were high among our sample: nearly one in three participants were at high risk for clinical depression at baseline compared to 7.6% in the general adult population [33]. The constraints of coping with depression could have prevented these participants from experiencing the treatment effect. A needs assessment of maintenance of weight loss over time identified chronic stress—a factor highly correlated with depression—as the most significant obstacle [39]. Similarly, having access to resources to cope with stress is associated with increased odds of sustained weight loss [41]. Our findings point to the potential for depression to act as an inhibitor of weight loss. Both the overall intervention effect and the effect among those without depression at baseline were of greater magnitude among women than among the overall sample, even though men started the intervention with a higher BMI than women [6]. As Mitchell et al. discuss, it is possible that the intervention was more feasible for women—many more women than men were recruited for and completed the program—due to the fact that intervention staff and educators (promotoras) were women [6]. These differences are also important for the current study because women in general are more likely than men to experience

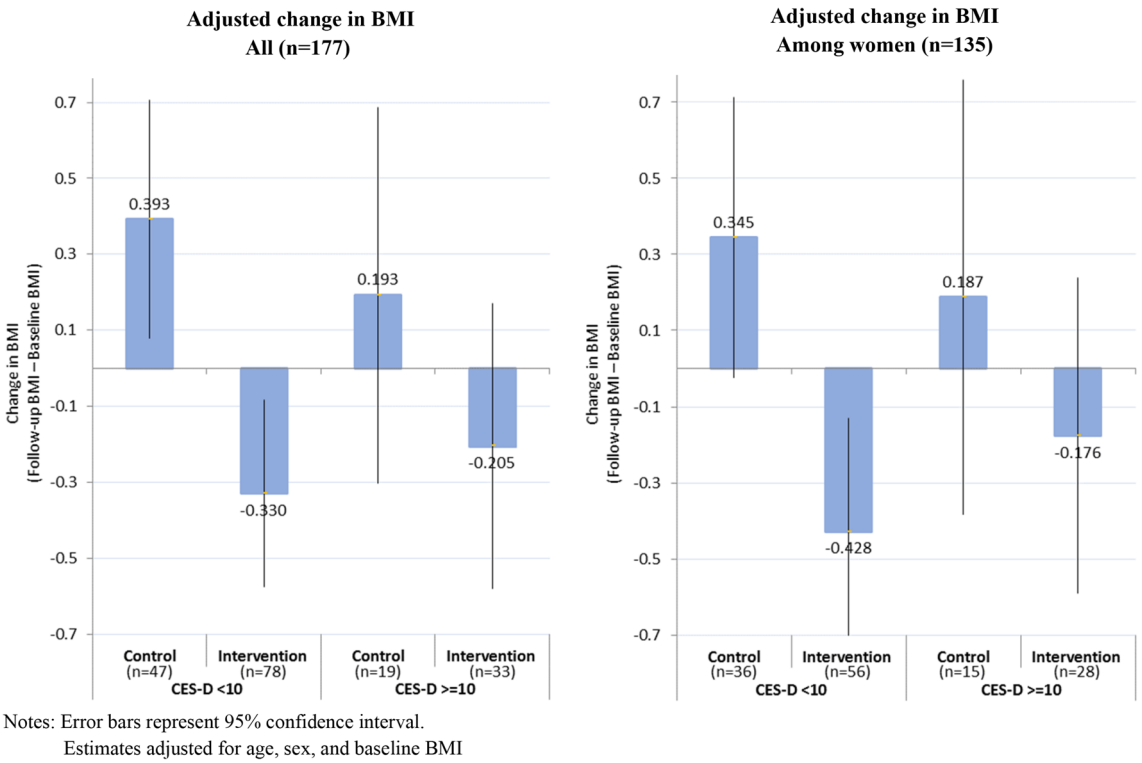

Fig. 2 Adjusted change in BMI (follow-up BMI minus baseline BMI) by treatment and baseline depressive status. *Notes* error bars represent 95% CI. Estimates adjusted for age, sex, and baseline BMI

depressive symptoms (or report experiencing depressive symptoms) [33]. Therefore, it may be especially important to address mental health in weight loss/diabetes interventions for women.

Moderation analyses of treatment effects can provide information about differential effects for certain subgroups and under certain circumstances. Our findings that the presence of depression at baseline may hinder participants from experiencing the overall treatment effect identified in the pilot PASOS study do not imply that future interventions will not be effective for this subgroup. Rather, they suggest that those developing and implementing interventions incorporate extra support for these individuals or for participants broadly. Even those not depressed at baseline could get a boost from this support and perhaps see longer lasting effects of initial weight loss. In face of the tremendous stressors they confront on a daily basis, such as marginalization, social isolation, fear of deportation, and unsafe working and living conditions [16, 19–23, 27–32], immigrant farmworkers display incredible resiliency [14]. Researchers and practitioners have much to learn from farmworkers themselves about the coping tools and resources they draw upon. Incorporating these tools and resources into obesity interventions could increase their effectiveness and tackle high rates of depression. Links to and facilitation of external resources, such as health insurance and access to mental healthcare services, are also equally if not more important to begin to improve both mental and physical health outcomes. Comprehensive policy changes will also be necessary to move the needle on the high rates of depression observed in this and other studies of immigrant farmworkers. The current policy environment, in particular changes in immigration enforcement, will likely exacerbate many of the stressors facing this population [14, 16, 52–56]; thus, continued attention to mental health will be of increasing importance moving forward.

Given the complexity of the etiology of both obesity and mental health, it is also clear that in order to see substantial improvements greater support systems are necessary at a structural level. To improve the overall health of the immigrant farmworker population, access to comprehensive services across a number of arenas must be addressed, and there are several specific programs that could have a direct impact on obesity and mental health. For example, equitable access to nutrient-rich foods is an essential piece of the puzzle to improving disparities in obesity rates, yet immigrant farmworkers face high levels of food insecurity [3, 26]. Facilitating access to Supplemental Nutrition Assistance Program (SNAP) and Women, Infants, and Children (WIC) benefits is a potential mechanism to improving food security [57], and is especially important given the relationship between obesity/diabetes, depression, and food insecurity [58]. However, a recent study found low SNAP participation rates among

immigrant farmworkers (vs. citizens) [59]. WIC, on the other hand, appeared to be more accessible to farmworkers, perhaps given that eligibility and enrollment are less restrictive than for SNAP benefits [60]. Finally, without improving access to health insurance and health care, the likelihood of a number of conditions related to disparities in obesity and mental health remaining undiagnosed and untreated will remain high [33, 61].

Limitations

Our study includes many strengths, in particular, the uniqueness of the *Pasos Saludables* pilot study contributes to understanding of how to best support weight loss efforts among a population that is highly marginalized. Yet, there are limitations to our analysis that prevent us from speaking definitively about the role of mental health as a moderator. First, because this was a post-hoc analysis of a pilot study that informed the implementation of a larger study, the precision of our estimates is not ideal. The lower power of our moderation analysis may contribute to why no significant treatment effect was observed for the group at risk for depression at baseline. However, producing precise estimates from a pilot study is often not the primary goal. Rather, pilot studies help us to better understand and explore the multiple factors at work in the intervention's effectiveness. There is reason to believe psychosocial factors such as mental health may influence weight loss and weight loss interventions, and the present study suggests as much. Future, larger studies should further explore and formally test this hypothesis.

Second, because intervention participants with no indication of depression were more likely to be lost to follow-up than their counterparts in the control arm, our estimates could be biased. These participants were lost to follow-up so no further data could be collected from them. Intent-to-treat analyses are important for randomized studies implemented in the real world because they reflect the fact that not everyone will actually complete or participate at the same level. Thus, it is important to know what the population effect is given this reality. However, as-treated analyses are also important to test the specific impact of an intervention in an ideal setting where participants complete the intervention. Our primary findings reflect as-treated analyses, but we also conducted sensitivity testing to model outcomes for those who were lost to follow-up. Findings from these sensitivity analyses were consistent with as-treated analyses.

Conclusions

Latino immigrant farmworkers face both high rates of obesity and poor mental health. *Pasos Saludables* achieved significant weight loss for participants in this population through a workplace lifestyle intervention program. However, depression may hinder the initiation and maintenance of the substantial changes associated with sustained weight loss. A combined approach is needed to both improve mental health and lower obesity in this particularly marginalized population but likely needed in the general population as well. Obesity is seen as a major, if not the major, chronic health problem our nation faces, but without tackling associated barriers, such as poor mental health, maximal benefit to the whole population will not be achieved.

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Data Availability The datasets generated during and/or analyzed during the current study are not publicly available due to stipulations in the informed consent obtained from participants but are available from the corresponding author on reasonable request.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest.

Ethical Approval The *Pasos Saludables* study was reviewed and approved by the University's Institutional Review Board (IRB). All procedures performed in studies involving human participants were in accordance with the ethical standards of the University IRB and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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

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