

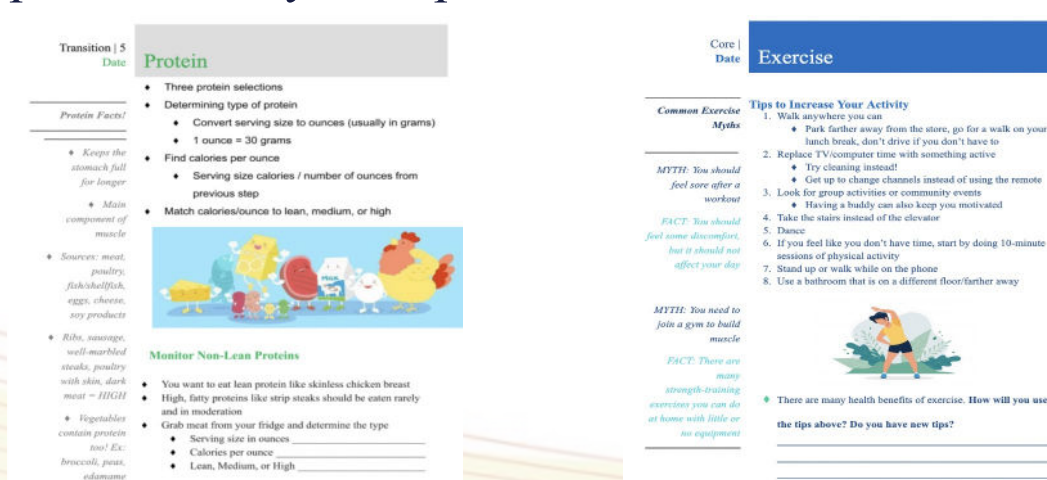
## Purpose

Obesity and depression are estimated to affect 34.6% and 7.2% of American adults, respectively<sup>1,2</sup>. These increasingly prevalent diseases are both linked to substantial morbidity and mortality along with increased risk of cardiovascular disease<sup>3</sup>. Individuals with depression are at increased risk for obesity and vice versa<sup>1,3</sup>. Effective interventions that address both ailments are imperative. Previous trials have reported enhanced mental health status resulting from a weight loss intervention<sup>4</sup>. We have expanded upon this work by studying whether our intervention promotes motivation for health-related behavioral change. Based on social determination theory, autonomous motivation is a measure of internalized motivation for change, with higher autonomous motivation associated with more sustained change<sup>5,6</sup>. Our study aimed to assess the effectiveness of a low-cost, student-run nutrition education program in obese adults for improving weight, depression, and autonomous regulation for weight loss.

## Methods

Enrolled patients were randomized to usual care, or to participate in the Jefferson Weight Loss Program (JeffWLP) intervention delivered by student health coaches, overseen by a certified obesity management physician, and in consultation with a registered dietician. Treatment included weekly group and individual nutrition education counseling virtual (Zoom) sessions utilizing motivational interviewing, meal replacements, and an incrementally increasing walking exercise component. Physical activity was assessed using daily step counts recorded using the Outwalk mobile application, along with actigraphy at study baseline, 6 weeks (midpoint), and 12 weeks (endpoint). Vital signs, PHQ-9, and TSRQ questionnaires were also performed at these time points. The Patient Health Questionnaire (PHQ-9) is a validated tool for diagnosing and assessing severity of depression<sup>7</sup>; PHQ-9 scores of 5, 10, 15, and 20 indicate mild, moderate, moderately severe, and severe depression, respectively. A PHQ-9 score of 10 or higher is commonly used to identify clinical depression<sup>8</sup>. The treatment self-regulation questionnaire (TSRQ) is a validated tool for measuring autonomous motivation<sup>9</sup>. TSRQ scores are calculated by averaging numerical scores from questionnaires and range from 1 to 7 with higher scores indicating greater autonomous motivation. Two versions of the TSRQ were used to measure autonomous regulation of JeffWLP participants. The TSRQ Concerning Entering the Weight Loss Program was administered at baseline, and the TSRQ Concerning Continued Program Participation was administered at midpoint and endpoint.

Figure 1: Example of Weekly Group Session Curriculum Handouts



## Demographics

Table 1: Patient Characteristics at Baseline

Descriptor	Intervention (n=14)	Control (n=8)
Age (years)	52 ± 11	46 ± 13
Female Sex - no. (%)	12 (85.7)	7 (87.5)
Race - no. (%)		
White	4 (29)	2 (25)
Black	10 (71)	6 (75)
Baseline Weight (lbs)	232 ± 41	222 ± 26
BMI (kg/m <sup>2</sup> )	40.0 ± 5.5	36.3 ± 5.6
PHQ-9 Depression Scale	4.9 ± 4.6	6.4 ± 5.7
TSRQ Autonomous Regulation	5.3 ± 0.9	5.3 ± 1.0

## Results

The prevalence of depression indicated by PHQ-9 ≥10 at baseline in the entire study cohort was 17%. As will be reported uniquely in another upcoming research meeting, JeffWLP participants achieved statistically and clinically significant weight loss at completion of the 12-week program. Intervention group participant mean PHQ-9 depression scores improved from 4.9 ± 4.6 at baseline to 3.1 ± 3.3 at program completion, representing a significant decrease of 1.7 ± 2.7 points (p = 0.03). This change signifies an improvement from mild to no depression. Intervention group participant autonomous motivation scores improved from 5.3 ± 0.9 to 6.1 ± 1.0, representing a significant increase of 0.83 ± 1.0 points (p = 0.01) from baseline to completion. An increase in weekend steps walked was correlated with improvement in PHQ-9 scores (R= 0.8, p = 0.03). However, improvement in depressive symptoms or autonomous regulation did not correlate significantly with weight loss at endpoint, or class participation.

Table 2. Primary Psychosocial Outcomes (Positive value indicates a decrease (improvement) in a given variable at endpoint when compared to start of trial)

Primary Outcome	Average	p-value
Change in Depression Index (PHQ-9)	1.7 ± 2.7	0.03
Change in Autonomous Regulation (TSRQ)	0.83 ± 1.0	0.01

## Graphics

Figure 2: Participant Depression Scale as measured by PHQ-9 at program start and completion

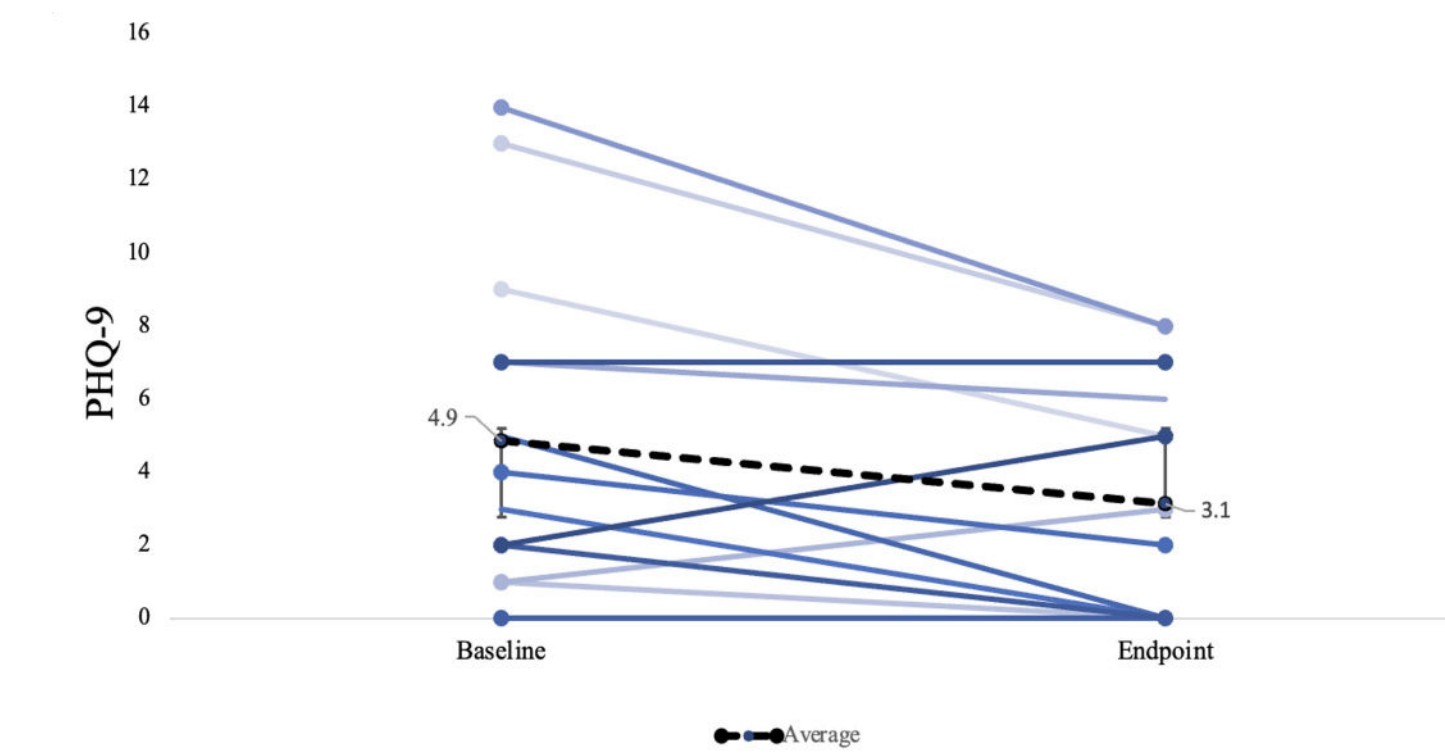
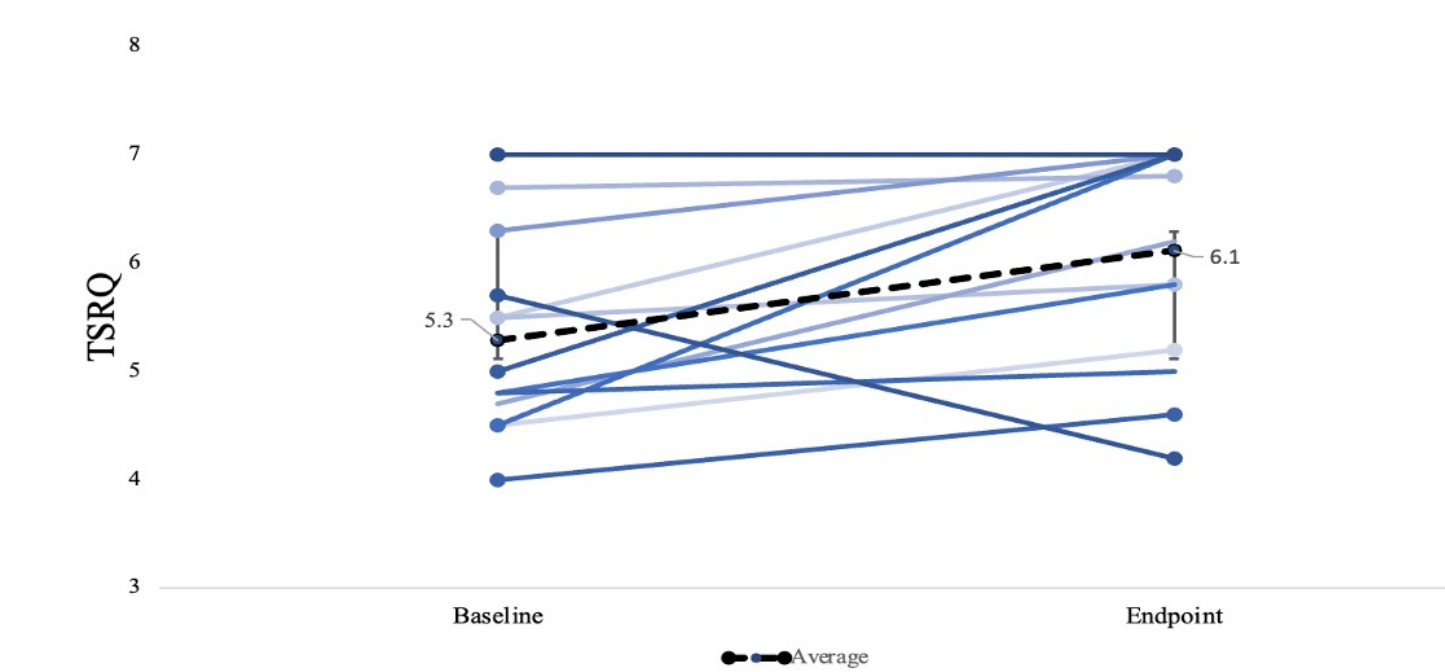


Figure 3: Participant Autonomous Regulation as measured by TSRQ at program start and completion



## Discussion

Participants in the JeffWLP demonstrated significant improvement in both depressive symptoms and autonomous regulation, affirming the program's positive impact on mood and fostering self-determination. Higher autonomous motivation is associated with a higher likelihood of sustaining desired change, supporting the maintenance of healthy behaviors and eating habits long term. Although the observed change in autonomous regulation after three months was modest, we anticipate and will assess continued improvement over time. Additionally, the positive correlation between step count and depressive symptoms was consistent with the association noted in previous research between increased physical activity and improved depressive symptoms<sup>8,9</sup>.

The goals of our program extend beyond weight loss; improved nutrition, physical activity, and cardiovascular risk were also emphasized. While our findings are limited by the small sample size and short duration, the positive results, despite these limitations, are promising. The program is ongoing, and we anticipate continued, sustained improvements as we accrue and follow more participants over time.

## Conclusion

Our randomized controlled trial demonstrated that a novel low-cost, student-run nutrition program significantly improved depressive symptoms and autonomous motivation in obese adults. Participants showed decreased PHQ-9 depression scores, indicating a change from mild to no depression, along with increased autonomous regulation for sustaining healthy behaviors. Higher weekend step counts also correlated with improved mood. The program's efficacy and replicability can provide an effective, scalable resource for medical schools nationwide to address the comorbid epidemics of obesity and depression. Our methodology impacts both conditions. By fostering self-determination and improved mood, we hope to motivate long-term healthy lifestyle changes and inspire similar initiatives promoting well-being in other obese populations.

## Acknowledgements

We would like to extend a sincere thank you to Dr. Cynthia Cheng for serving as the Principal Investigator, the SKMC medical students for helping with participant recruitment and serving as health coaches, and Cheryl Marco who inspired the creation of JeffWLP and provided support and guidance.

## References

1. CDC. National Health and Nutrition Examination Survey data. Hyattsville, MD: National Center for Health Statistics. 2005–2010.
2. Goodwin RD, Dierker LC, Wu M, Galea S, Hoven CW, Weinberger AH. Trends in U.S. Depression Prevalence From 2015 to 2020: The Widening Treatment Gap. *Am J Prev Med.* 2022 Nov;63(5):726-733. doi: 10.1016/j.amepre.2022.05.014. Epub 2022 Sep 19. PMID: 36272761; PMCID: PMC9483000.
3. Blasco BV, Garcia-Jiménez J, Bodoano I, Gutiérrez-Rojas L. Obesity and Depression: Its Prevalence and Influence as a Prognostic Factor: A Systematic Review. *Psychiatry Investig.* 2020 Aug;17(8):715-724. doi: 10.30773/pi.2020.0099. Epub 2020 Aug 12. PMID: 32777922; PMCID: PMC7449839.
4. Fabricatore AN, Wadden TA, Higginbotham AJ, Faulconbridge LF, Nguyen AM, Heymsfield SB, Faith MS. Intentional weight loss and changes in symptoms of depression: a systematic review and meta-analysis. *Int J Obes (Lond).* 2011 Nov;35(11):1363-76. doi: 10.1038/ijo.2011.2. Epub 2011 Feb 22. PMID: 21343903; PMCID: PMC3139753.
5. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol.* 2000;55:68–78. doi: 10.1037/0003-066X.55.1.68.
6. Ryan RM, Deci EL. A self-determination theory approach to psychotherapy: The motivational basis for effective change. *Can Psych.* 2008;49:186–193.
7. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* 2001 Sep;16(9):606-13. doi: 10.1046/j.1525-1497.2001.016009606.x. PMID: 11556941; PMCID: PMC1495268.
8. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* 2001 Sep;16(9):606-13. doi: 10.1046/j.1525-1497.2001.016009606.x. PMID: 11556941; PMCID: PMC1495268.
9. Levesque CS, Williams GC, Elliot D, Pickering MA, Bodenhamer B, Finley PJ. Validating the theoretical structure of the Treatment Self-Regulation Questionnaire (TSRQ) across three different health behaviors. *Health Educ Res.* 2007 Oct;22(5):691-702. doi: 10.1093/her/cyl148. Epub 2006 Nov 30. PMID: 17138613.