

## Abstract

# Predicting Clinically Significant Weight Loss in a Multimodal Commercial Digital Weight Management Program: Machine Learning Approach

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## Abstract

**Background:** Generally, adherence to diet and physical activity in behavioral weight management programs predicts weight loss. Moreover, meeting attendance and platform or app use predict weight loss. Many weight-loss–prediction studies primarily use regression. However, little is known about the levels of adherence to specific web-based weight management program tools as well as behavioral and psychosocial variables that predict significant weight loss using machine-learning approaches.

**Objective:** In this paper, we aimed to examine variables that can predict clinically significant weight loss ( $\geq 5\%$ ) in a multimodal commercial digital weight management program, including levels of adherence to intervention tools and changes in behavioral and psychosocial states using machine-learning approaches.

**Methods:** We performed secondary analyses using data from a one-arm trial online WW (formerly Weight Watchers) weight-loss intervention program, lasting 6 months, that recruited US adults with a BMI range of 25–45 kg/m<sup>2</sup>. We used a WW Bluetooth scale and digital intervention tools such as mobile app for point tracking, weekly virtual workshops, weekly wellness check-ins and a Facebook group, and changes in psychosocial and behavioral variables (ie, food craving, Pittsburgh sleep quality index, diet, hunger, and physical activity). Using the receiver operating characteristics (ROC) curve, we identified the predictors of significant weight loss, as well as the associated cut points (CP) and area-under-curve (AUC) values for each variable. We further used a classification tree to confirm the importance of these predictors and assessed the out-of-sample prediction accuracies using 5-fold cross-validation.

**Results:** Participants (N=153) were 70% female and 66% White, with a mean age of 41.09 (SD 13.78) years, and had a mean BMI of 31.8 kg/m<sup>2</sup> (SD 5.0). Approximately 51% of participants lost  $\geq 5\%$  weight. Using ROC curve, food tracking (CP $\geq 9.4\%$ ; AUC=0.744;  $P < .001$ ), increase in self-weighing (CP $\geq 0.5$ ; AUC=0.733;  $P < .001$ ), wellness check-in attendance (CP $\geq 31.3\%$ ; AUC=0.723;  $P < .001$ ), and workshop attendance (CP $\geq 35.4\%$ ; AUC=0.699;  $P < .001$ ) were identified as significant predictors of achieving  $\geq 5\%$  weight loss. We confirmed the importance of these variables using classification tree, and together they achieved an out-of-sample prediction accuracy of 78%.

**Conclusions:** ROC curve and classification tree provided consistent results of predictors of clinically significant weight loss (ie, food tracking, increase in self-weighing, workshop attendance, and wellness check-in attendance). Our study extends the weight management literature by using machine-learning approaches to identify significant weight loss predictors and specific levels of these predictors needed to achieve clinically significant weight loss.

**Conflicts of Interest:** None declared.

(*iproc* 2023;9:e39574) doi: [10.2196/39574](https://doi.org/10.2196/39574)

**KEYWORDS**

weight loss; digital weight management program; machine learning

*Edited by T Leung; this is a non-peer-reviewed article. Submitted 15.05.22; accepted 22.12.22; published 23.01.23.*

*Please cite as:*

*Bannor R, Pagoto S, Cardel MI, Lee A, Foster GD, Xu R*

*Predicting Clinically Significant Weight Loss in a Multimodal Commercial Digital Weight Management Program: Machine Learning Approach*

*iproc 2023;9:e39574*

*URL: <https://www.iproc.org/2023/1/e39574>*

*doi: [10.2196/39574](https://doi.org/10.2196/39574)*

*PMID:*

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