Sequential Changes Advancing from Exercise-Induced Psychological Improvements to Controlled Eating and Sustained Weight Loss: A Treatment-Focused Causal Chain Model

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ABSTRACT

Introduction: Behavioral (nonsurgical/nonpharmacologic) weight loss treatments have been overwhelmingly unsuccessful beyond the short term. Rather than incorporating accepted behavioral change theory, most have inadequately relied on providing exercise and nutrition information. Although adherence is a challenge, exercise has emerged as the most robust predictor of sustained weight reduction. However, exercise might be more associated with long-term weight loss through the relationship of its associated psychological changes with improved nutrition than through direct effects of energy expenditures, which are typically minimal in deconditioned individuals.

Objective: To facilitate improved helping methods through a proposed theory-based causal chain model in which supported exercise predicts sustained weight loss through successive changes in exercise-related, then eating-related, self-regulation, self-efficacy, and mood.

Results: Segments of the model predict that 1) exercise and eating behaviors will be sequentially improved through increased self-regulatory skill use and self-efficacy and 2) exercise-induced mood improvements will foster greater self-regulation and reduced emotional eating. Short-term psychosocial changes can be leveraged to carry over to longer-term changes and maintained weight reductions. Suggested interventions emerging from the model and supporting research include using self-regulation to enable a habit of regular moderate exercise, facilitating a transfer of self-regulatory skills from an exercise to eating context, and leveraging mood improvements associated with manageable volumes of exercise to improve eating behaviors.

Conclusion: The model presents an evidence-based explanation of the exercise-weight loss association through psychosocial mechanisms. It also informs the development of practical methods to facilitate sustainable reductions in weight and health risks in adults with obesity.

INTRODUCTION

The persistent inability to reduce excess weight is associated with health risks, including the cardiovascular disease-related conditions of type 2 diabetes, hypertension, and hypercholesterolemia; various cancers; and musculoskeletal disorders. Compliance with behavioral changes required to manage weight has been extremely problematic. However, most nonsurgical and nonpharmacologic treatment methods for obesity have been atheoretical. These methods are related to the spurious assumption that informing individuals about the need to be more physically active and to eat in a healthier manner will improve those weight management behaviors. However, less than 4% of US adults complete the minimum amount of exercise required for health, and approximately 72% of Americans are at a higher-than-healthy weight.

Examination of the association between the considerable amount of information already provided and the present levels of exercise and overweight/obesity in the US supports the need for the development of a viable but practical explanatory model capable of better shaping helping methods. Preferably these techniques would be able to be applied in an efficient and cost-effective manner.

Adding to that challenge is the realization that even state-of-the-art cognitive-behavioral methods have been deficient at facilitating sustained changes in weight loss behaviors for decades. After treatment is initiated, weight loss consistently plateaus within 6 to 9 months. A near-complete weight regain then begins and persists. Senior behavioral scientists cite even their own carefully prepared but failed treatments as evidence of the futility of attempting sustained weight loss. Because of an unmistakable inability to alter weight management behaviors over the long term, some researchers professed that further efforts toward development of behavioral interventions are useless and thus should be terminated.

Other researchers, along with this article’s author, disagree with the suggestion to end applied research activities in the behavioral weight management treatment arena. Yet, it cannot be refuted that sustained weight reduction has been “a problem that simply does not yield to treatment” and “most obesity prevention interventions have attained only limited or no behavioral changes … and have rarely impacted targeted physiological or anthropomorphic health outcomes.”

Most researchers concur that considerable innovation would be required for any future chance at success. Possibilities for the use of behavioral methods as an adjunct to bariatric surgery and pharmacotherapies were posited. However, the prospect of exercise holding importance well beyond its relatively minor direct function in weight loss (because energy expenditures are minimal in deconditioned individuals) was also advanced as a possible cost-effective basis for large-scale intervention.

It was acknowledged, however, that adherence to regular exercise regimens was problematic,

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Keywords: adherence, behavioral medicine, evidence-based, health education, integrative medicine, Lifestyle Medicine, nutrition, obesity, preventive, weight
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**Foundations of a Predictive Model for Behavioral Change**

Before development of a theory-based causal chain model, a review of the related research was conducted considering the mediation/moderation framework for analyses of behavioral obesity reduction processes suggested by Baranowski and colleagues.\(^\text{18}\) This review was influenced by the following factors: 1) research indicating that exercise is the strongest predictor of success with sustained weight loss;\(^\text{20,30,31}\) 2) a previously proposed model suggesting a path from exercise to weight loss that included improvements in mood, well-being, body image, self-efficacy (ie, feelings of ability/compe-
tence), self-esteem, and coping leading to increased commitment, more psychological resources, and improved adherence to diet and exercise;\(^\text{20}\); and 3) a path where interrelations between exercise-related and eating-related self-regulation and self-efficacy were identified.\(^\text{26,27}\) Results of subsequent investigation indicated that the changes in self-regulation, self-efficacy, and mood that explained large portions of the variances in exercise and healthy eating behaviors over 6 months will, under the correct conditions, also be associated with maintained changes.\(^\text{32,33}\) Such self-regulatory skills included methods such as managing negative self-talk, preparing for inevitable behavioral lapses, and setting interim goals. Research findings also supported propositions that exercise-associated psychosocial improvements carry over, or generalize, to parallel psychosocial predictors of eating changes in the presence of behavioral treatments focused on self-regulation.\(^\text{34-38}\) Additionally, eating changes (as opposed to energy expendi-
tures) explain the preponderance of the variance in weight loss.\(^\text{26,39}\)

It should be noted, however, that when a treatment does not purposefully develop its participants' self-regulatory skills (ie, instead use only their existing skills), their usage might diminish for use in controlling eating because they have been "depleted" by their focus on maintaining regular exercise.\(^\text{34,35}\) Moreover, other research findings indicated that also accounting for emotional eating would be productive,\(^\text{41}\) and various theory- and research-based relationships (eg, between exercise-induced mood change and emotional eating; effects of mood change on self-regulatory skills use) required better accounting for longer-term changes in behaviors. Various other tested psychosocial predictors of behavioral changes (eg, body satisfaction, self-motiva-
tion, self-concept) were excluded from consideration for a next-generation pre-
dictive model because of either covariance issues demonstrated with other predictors or trivial additional impacts on the essen-
tial behavioral changes and weight loss.

**Use of the Causal Chain**

As an extension of the research, a re-
vised model is proposed in this article using a causal chain design.\(^\text{42}\) A causal chain is an explanatory process in which behaviors and psychosocial factors are posited to exist in ordered schemas. Such schemas should be congruent with accepted theory, and both predictor and mediator variables might be expected to be affected by a treatment.\(^\text{43}\) Hardeman and colleagues\(^\text{44-46}\) suggested that causal modeling presents a fresh opportunity for the development and testing of health behavior-change interventions, which they assert, "remain at an early stage." In the proposed causal chain model, key tenets of social cognitive theory,\(^\text{44,45}\) self-efficacy theory,\(^\text{46}\) and self-regulation theory\(^\text{47,48}\) are incorporated. Accordingly, there is an expectation that increased self-regu-
lation will predict perseverance through lifestyle barriers, improved self-efficacy will foster persistent goal striving, and enhanced mood will generate a positive and reinforcing psychological climate that facilitates behavioral progress.\(^\text{28}\) Research is also incorporated on the generalization of self-regulation and self-efficacy across health-related tasks\(^\text{35,38,49}\) (here, exercise to healthier eating). In addition to pro-
viding an overall "shape" to the model, this theory-based emphasis additionally restricts the plethora of relationships pos-
sible among those and other variables.\(^\text{50}\) It furthermore limits probative analyses and statistically capitalizing on chance that are, unfortunately, common in applications of structural equation modeling.\(^\text{51}\) Although often of minimal concern to the practi-
tioner, resolution of these methodologic issues is of considerable import for the validity of an emergent model.

In the present synthesis of research, although the inevitability of idiosyncratic differences across individuals with obe-
sity is acknowledged, a somewhat deter-
mindistic view is incorporated that might ultimately enable numerous individuals to finally be helped through standardization of methods arising from relationships in a sound predictive model. Because the use of multiple experiments to explain aspects of a causal chain has been viewed as optimal\(^\text{52}\) and identified as effective within a context of dietary change,\(^\text{52}\) those processes formed the basis of the present model's systematic development. This was a unique advantage. Far from being an intellectual exercise that is common in research-oriented abstrac-
tions, the overall goal of the model being proposed is clear: To create a structure in which evidence-based methods facilitate meaningful improvements in both exercise and healthy eating behaviors that are reli-
ably sustained.
Focus on Real-World Applicability

Although some research posits matching treatments to causal models, the present concern was the development of a causal chain model in the presence of field-based treatments. This course of action allowed generalization to the real world to be maximized. Here, a fundamental aim was to seek an understanding of “active ingredients” of treatment effects so that processes might be accordingly developed, prioritized, and timed. This practical use of theory and the extant research has been cited as a gap in weight management intervention research concerned with long-term effects. Additionally, considering that a further aim of this research was to support effects that have sometimes been defined as separate (ie, initial weight loss vs sustaining lost weight), the model discussed here reflects this. The extensive research literature on the transtheoretical model supports the approach of accounting for psychosocial effects on behaviors that are based on distinct stages (eg, development of a behavior vs maintenance of that behavior). Because what might be the most important aspect, that is, maintenance of behavioral change, has typically been omitted in related research, that matter received equal attention to the essential task of establishing initial change. Given this, marked attention was devoted to accounting for the transfer of the psychosocial conditions enabling short-term weight loss to those facilitating maintained loss (and accompanying reductions in health risks).

MODEL DESCRIPTION

A newly developed causal chain model is outlined that takes into account the following: 1) the need for an innovative treatment direction, 2) research demonstrating that exercise is the strongest predictor of sustained weight loss, 3) demonstrated relationships between psychosocial correlates of exercise and eating improvements, and 4) the need to address weight loss and weight loss maintenance as distinct issues. The model is conveyed in 2 interrelated parts: A weight loss phase (initial 6-9 months after treatment initiation) and a weight loss maintenance phase (beyond 6-9 months after treatment start). For ease of interpretation, components of the

Weight Loss Phase

Figure 1. Causal chain from exercise-induced psychosocial changes, to eating-related psychosocial changes, to sustained weight loss. A newly developed causal chain model is outlined that takes into account the following: 1) the need for an innovative treatment direction, 2) research demonstrating that exercise is the strongest predictor of sustained weight loss, 3) demonstrated relationships between psychosocial correlates of exercise and eating improvements, and 4) the need to address weight loss and weight loss maintenance as distinct issues. The model is conveyed in 2 interrelated parts: A weight loss phase (initial 6-9 months after treatment initiation) and a weight loss maintenance phase (beyond 6-9 months after treatment start). For ease of interpretation, components of the
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Relationships Embedded in the Model
At its basic level, the new causal chain model proposes that under behavioral treatment conditions, psychosocial predictors of increased exercise will be associated with parallel psychosocial changes related to eating behaviors during the weight loss phase. These are associated with reductions in unfavorable eating behaviors and weight during that period. The targeted psychosocial improvements from the weight loss phase will then transfer to maintained weight loss during the weight loss maintenance phase. The proposed mediation-based segments, relationships bridging those segments (eg, carryover of psychosocial changes from exercise to eating contexts), and moderators of relationships are described here, supported by a pointed representation of their associated research findings through provided references. At a fundamental level, model-based predictions are supported by both Bandurian and self-regulation theory, with additional confirmation from the many cited studies.

In segment 1 of the model (top left in Figure 1) during the weight loss phase, increased exercise is predicted by increased exercise-related self-regulation through (ie, mediated by) associated improvements in exercise self-efficacy. As suggested by Gendolla and Brinkman and supported by treatment research in the present realm, one’s initial mood is predicted to moderate the exercise self-regulation–physical activity relationship.

In segment 2, change in exercise behavior serves as the predictor variable. Its association with improved mood is posited to be through improved exercise self-efficacy. This is supported by research suggesting that most exercise-induced change in mood is induced via improvements in feelings of accomplishment (ie, self-efficacy) rather than often-posed biochemical changes. Leading into segment 3, exercise self-regulation change is proposed to carry over to eating-related self-regulation, change in exercise self-efficacy is posited to carry over to eating-related self-efficacy change, and change in mood is a proposed moderator of the change in eating self-regulation–positive eating behavior change relationship.

In segment 3, the relationship between changes in eating-related self-regulation and positive eating behaviors is proposed to be mediated by change in eating-related self-efficacy. In the related research, the decision to enter positive vs unfavorable eating behaviors in segment 3 was influenced by the stronger relationships of self-regulation with positive eating behaviors previously identified. This was somewhat arbitrary, and the significant interrelationship is addressed in the account of segment 5.

Part of segment 4 is represented with dashed lines where change in emotional eating enters the model. This is because of a lack of clarity on whether the effect of mood change on eating behavior encompasses the construct of “emotional eating” or not. The reader is left to judge this nuance in terminology. However, assuming that it is a distinct construct, the prediction of negative mood change’s effect on change in positive eating behavior is proposed to be mediated by emotional eating change.

Leading into segment 5, it is contended that increased emotional eating will predict increases in unfavorable eating behaviors. In this segment, the effect of increased positive eating behaviors on weight loss is proposed to be mediated by a reduction in unfavorable eating. This portion of the model is supported by research suggesting that the positive eating behavior of increased fruit and vegetable consumption affects the diet as a whole, including reducing unfavorable eating behaviors such as the intake of sweets, and its effects on weight in a behavioral treatment context.

Supported by recent findings, in segment 6, the increases in eating-related self-regulation over the weight loss phase are purported to increase eating-related self-regulation into the weight loss maintenance phase through eating-related self-efficacy changes attained in the weight loss phase. Research findings also suggest that the transfer of early increases in eating-related self-regulation to their longer-term improvements is associated with the degree of treatment attention provided to self-regulatory skills development (vs more customary activities related to nutritional advice). The association of increased self-efficacy developed through feelings of ability derived from self-regulating through barriers was addressed earlier, in segments 1 and 3.

In segment 7, the prediction of weight loss sustained over the weight loss maintenance phase by the eating-related self-regulation changes during that period is proposed to be moderated by the degree of negative mood present in the weight loss maintenance phase. The research on mood’s effect on self-regulation was again the basis of that proposition, which was also adequately supported in the present context. Also supported was that the effect of the aforementioned moderation by mood during the weight loss maintenance phase is, in turn, affected by exercise amounts completed during that phase. Because it remains unclear what volume of exercise is required to sustain exercise-induced improvements in mood, both its mean value and change during the weight loss phase is presently being investigated. With formerly sedentary adults, our preliminary findings suggest that 3 moderate exercise sessions per week are adequate.

Model-Based Treatment Directives
Success or failure with weight loss can often be synopsized via the constant
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With that in mind and remaining in this article’s intended parameters, treatment facets are proposed on the basis of the causal chain model and its supporting data as well as the field-based treatment context in which those data were acquired (Table 1).

Assessing Generalizability

Assessment of outcomes and additional decomposition of effects requires further testing across sample types (eg, ages, sexes, ethnicities, medical disorders beyond excess weight, pre/post bariatric surgery, degrees of overweight/obesity, degrees of physical mobility, using pharmacotherapies, with psychiatric/psychological disorders), and treatment administration formats (eg, group, individual, face-to-face, electronically supported, manual based). Although an aim of the predictive model is large-scale applicability across individuals with excess weight, it is also possible that, after further study, adjustments by subgroups will be indicated. However, any such treatment alterations should be evaluated against the advantages (eg, logistical, cost) of a single standardized protocol applicable across venues capable of supporting its widespread dissemination (eg, community health centers, YMCAs, health maintenance organizations).

Limitations and Strengths

The clear advantage in the development of the proposed model was our nearly continuous compilation of relevant data since 1997. This was made possible because the associated treatment components were operationally embedded in a large community-based organization concerned with changing health behaviors and improving health risks. This provided a unique opportunity for our sustained and systematic program of field-based inquiry. However, given the behavioral nature of the proposed causal chain, it is beyond the present scope to propose interrelationships between behavioral and physiologic factors regarding weight change. Hence, although controlled eating will be associated with reduced body weight because of an overall reduction in energy intake, analyses of possible relationships such as the effect of increased exercise on body composition and resting metabolic rate, and increases in consumption of fruits and vegetables on lean body mass, should be attended to in future research.

Strengths of the model, including some based on methodologic aspects, include the following:

- Findings that used a lagged variable approach, in which gains observed over an earlier temporal period predicted longer-term changes in outcome variables, were prioritized. That condition addresses possible reciprocal relationships (and directionality opposite from expectations) among incorporated factors.
- Where mediators and moderators are included in the causal chain, actual determinants of targeted gains were clarified and could also be accordingly addressed in treatment applications. That could beneficially drive both the timing and prioritization of intervention components. Also, such sequencing allowed an outcome variable in one area of the causal chain to serve as a predictor in a subsequent section.
- Variables selected for inclusion in the model were reasonably malleable. For example, although factors such as educational level and socioeconomic status might predict (covary with) behaviors associated with reduced weight, if emergent interventions are to be pertinent across demographic groups, accounting for such in the model would not be practically useful.
- Following from a goal of applicability, the dynamic processes in interventions were represented by change (gain) scores. Although cross-sectional research is (too) common in the area of health behavior change, data that characterize change best reflect both dynamic intervention effects and their impacts in a sequence of associations, ultimately leading to improvements in exercise and eating, their maintenance, and associated changes in weight.

- Although the basis of the causal chain design emanates from seminal principles of mediation analysis, recent extensions of those tenets that do not require a predictor and outcome variable to initially demonstrate a significant bivariate relationship were also incorporated in the guiding research.

CONCLUSION

Predictive models on the effects of exercise on weight loss through psychosocial processes have been scarce. Exceptions are Baker and Brownell, who proposed that exercise affects the relations of psychologic- al mechanisms (eg, body image, coping) and physiologic mechanisms (eg, resting metabolic rate, appetite) that foster weight control, and our own earlier research positing interactions between physical activity-related and eating-related self-regulation and self-efficacy, and mood. Rather, what has been available in the area is studies limited by 1) cross-sectional analyses, 2) post hoc interpretations of relationships among variables, 3) a lack of decomposition of treatment effects, 4) an irrelevance of short-term findings, and 5) a lack of generalizability of results to applied settings. Even the emerging research on the phenomenon of coaction (ie, taking action on one treated behavior increasing the probability of taking action on a second behavior) related to weight management has not yet proposed a causal framework. Also, the few investigations testing sequential applications of exercise and nutrition intervention components have been limited by a lack of decomposition of effects through potential mediators, failure to assess impacts on overweight and obesity, and an absence of intention-to-treat formats (ie, having self-select biases). Given their design limitations, some studies simply presumed that effects carry over from exercise to eating improvements, without identifying possible mechanisms.

The model proposed in this article addresses many of those limitations while also being the first explanatory paradigm found to focus on weight loss and weight loss maintenance as separate issues, as is suggested by much of the pertinent scientific literature.
Table 1. Practice suggestions based on proposed model

<table>
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<tr>
<th>Practice suggestion</th>
<th>Rationale</th>
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<tbody>
<tr>
<td>Use strong cognitive-behavioral methods that have demonstrated consistent support of adherence to exercise. 1,3</td>
<td>Without regular exercise, the probability of sustained weight loss is negligible.</td>
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<tr>
<td>Address self-regulation of exercise several weeks or months before initiating eating-behavior changes.</td>
<td>Help participants carry over the self-regulatory skills learned for maintaining exercise and to maintain improved eating.</td>
</tr>
<tr>
<td>Focus on increasing present volumes of exercise rather than the attainment of a &quot;gold standard&quot; (eg, 150 min/wk; expending 500 kcal per session).</td>
<td>Exercise session durations and intensities should be adjusted so that they are &quot;paired&quot; with positive (eg, rejuvenated) vs aversive (eg, exhausted) feelings. Adherence to even 2.5 to 3 moderate exercise sessions per week has been associated with the psychosocial predictors of healthier eating and weight loss. 1,5-7</td>
</tr>
<tr>
<td>Help establish behavioral goal measures for exercise (eg, minutes of cardiovascular exercise per wk), eating (eg, portions of fruits and vegetables per d), and weight loss (eg, caloric, or energy, intake per d) as clearly as possible.</td>
<td>Realize that even manageable amounts of exercise are associated with increases in the psychosocial predictors of eating changes (where most weight loss will be derived). 1,4 Realize that fruit and vegetable intake is associated with the health of the diet as a whole. 9 Regular self-weighting should be suggested. 10</td>
</tr>
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<td>Attainment of a short-term goal, or upholding a behavioral contract, should be distinctly indicated to help increase self-efficacy.</td>
<td>Rewarding one’s self should be used to mark progress periodically. However, greater than expected exercise volumes should not be rewarded by unhealthy foods.</td>
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<td>Require progress in behavioral and mood states to be diligently tracked to help facilitate increased exercise-related and eating-related self-efficacy.</td>
<td>Mood improvements reliably associated with as few as 2 or 3 sessions of moderate exercise per week should help reduce emotional eating. 12</td>
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<td>Add anxiety-regulating activities such as deep breathing and abbreviated progressive relaxation, which will be useful for situation-specific (stress-oriented) prompts to inappropriate eating.</td>
<td>Even though moderate to large effects on mood can be expected through exercise alone in formerly sedentary individuals, 11 this is an adjunctive suggestion.</td>
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<td>Treat weight loss and maintaining weight loss as separate aims.</td>
<td>Help participants denote weight loss goals that are sensitive to expected plateaus around the 6- to 9-month point so they are not perceived as a failure.</td>
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<tr>
<td>Improve self-regulation by spending the preponderance of treatment time in the instruction and rehearsal of self-regulatory skills such as cognitive restructuring, relapse prevention, and proximal goal setting with ongoing tracking of behavioral changes.</td>
<td>As such instruction progresses, provide more detail and training on how the skills learned in an exercise context can be adapted for ongoing use in controlling eating.</td>
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<td>Within the realm of increasing self-regulatory skills, address prompts to poor behaviors (eg, social pressures to eat), controlling problematic stimuli (eg, high food availability: fast foods), and understanding productive vs unproductive cues to eating (eg, through regularly self-eating safely levels).</td>
<td>Realize that challenging stimuli such as high presence of fast foods can, at best, be only minimized. Establishing feelings of hunger vs satiety (eg, on a 1-10 scale) helps control unhelpful prompts to eating.</td>
</tr>
<tr>
<td>Increase self-efficacy by helping participants acknowledge all forms of progress.</td>
<td>Mastery experiences 13 can be facilitated by underscoring when a newly learned self-regulatory skill enables a lifestyle barrier to be overcome. This can also increase other group participants’ sense of ability to accomplish the same (ie, vicarious learning).</td>
</tr>
<tr>
<td>Limit detailed discussion on nuances of the diet (eg, macronutrient proportions; supplements) because of the lack of evidence of their effects on weight loss and weight loss maintenance 12 and because the treatment time required limits more productive activities (eg, rehearsal of self-regulatory skills).</td>
<td>Realize that fruit and vegetable intake is alone a proxy for the overall adequacy of the diet. 14 When there is high interest, an individual can be directed to reputable, freely available sources for detailed nutrition information (eg, <a href="http://www.choosemyplate.gov">www.choosemyplate.gov</a>).</td>
</tr>
</tbody>
</table>

References
1. Annesi JJ. Supported exercise improves controlled eating and weight loss through its effects on psychosocial factors: Extending a systematic research program toward treatment development. Perm J 2012 Winter;16(1):7-18. DOI: https://doi.org/10.7812/TPP/11-136
9. Annesi JJ. Mastery of psychosocial factors in the relationship of increased fruit and vegetable intake with reductions in other food groups and weight in women with obesity. Minerva Psicofar 2018 March;59(1):1-9. DOI: https://doi.org/10.1007/s11572-017-01951-3
interrelationships addresses summary suggestions from the recent National Institutes of Health working group charged with providing suggestions for future research on improving maintenance of weight loss such as, “Clear constructs with better definitions are needed to improve our understanding of how the homeostatic, hedonic, and cognitive mechanisms that underlie eating and activity-related behaviors influence body weight regulation.”

Practical considerations were also attended to through the model’s ability to inform intervention. Ultimately, if physicians and other health care professionals can be armed with targeted health behavior change methods emerging from the proposed model, and they are supported through alliances with other professionals that are tailored to addressing sustained change in the same theoretically sound manner, chances for gaining control over obesity-related behaviors and outcomes are likely to increase exponentially. Many will agree that the realization of such a partnership between the behavioral science, medical professional, and wellness communities is considerably past due.

Disclosure Statement
The author has no conflicts of interest to disclose.

Acknowledgments
The author acknowledges the ongoing support of evidence-based applications of exercise adherence and weight management processes provided by him through the administration and staff of the YMCA of Metro Atlanta, Atlanta, GA, along with consistent intellectual contributions from a select few academicians dedicated to theory-based translational behavioral medicine. The research yielding the proposed model was influenced by numerous studies we conducted in the US, Canada, United Kingdom, and Italy; intervention evaluations provided by the National Institutes of Health/National Cancer Institute, Bethesda, MD; and individuals with positions ranging from health promotion professional and physician operations specialist and research methodologist. Appreciation is especially afforded the participants and practitioners involved in the associated research program, which continues.

References
29. DOI: https://doi.org/10.1037/0278-6133.19.Suppl1.5

Annesi JJ, Johnson PH. Theory-based psychosocial factors that discriminate between weight-loss success and failure over 6 months in women with morbid obesity receiving behavioral treatments. Eat Weight Disord 2015 Jun;20(2):323-32. DOI: https://doi.org/10.1007/s10654-014-0159-7 PMID:25332991


Annesi JJ. Relations of change in fruit and vegetable intake with overall energy reduction and physical activity change: A meta-analysis. Appetite 2020 Mar;146:39-47. DOI: https://doi.org/10.1016/j.appet.2019.09.024 PMID:31706989


Annesi JJ. Response vs. non-response to self-regulatory treatment targets is not discriminated by personal characteristics, but predicts physical activity, eating behavior, and weight changes in

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75. Annesi JJ. Moderation of psychological factors in the relationship of increased fruit and vegetable intake with reductions in other food groups and weight in women with obesity. Minerva Psichiatr 2018 Mar;59(1):1-9. DOI: https://doi.org/10.23736/S0391-1772.17.01951-3
78. Annesi JJ. Effects of treatment-associated increases in fruit and vegetable intake on the consumption of other food groups and weight through self-regulatory processes. Perm J 2018;22:17-143. DOI: https://doi.org/10.7812/TPP/17-143 PMID:29616916