**Testing Health Models in a Fitness Program**

Obesity is an epidemic that impacts approximately one out of every three Americans. Further breakdown of statistics from The Center for Disease Control (CDC, 2012), indicates 57.6% of Non-Hispanic Black women age 20 years are obese (2009-2012). Furthermore, the Alabama adult obesity rate is at about 33.5%. This indicates that diet and exercise would be beneficial for all Americans especially for African American adults in Alabama. How can health models improve efficacy of such programs? The researchers did statistical analysis of data collected during a wellness program to support use of three health theories within such programs.

A research study followed 3 years of cohorts, approximately 25 participants each year (85 participants total) for four months. The study included some common participants for two consecutive years (about six of them). Overall goals included: provide obesity prevention outreach and education, increase university capacity (including service learning and externship opportunities), and engage in applied research.  Education and outreach was in the form of an education and weight loss program to the university community and the community at large. The intervention was tailored to be culturally appropriate for the Black American population based on the setting, the educators, and personal trainers. This project was based on The Dietary Guidelines for Americans, 2010 including choosemyplate.gov, 2008 Physical Activity Guidelines for Americans and National Heart Lung and Blood Institute recommendations.

One aspect of the research sought to determine the efficacy of the models chosen, Health Belief Model (HBM), Transtheoretical Model (TTM), and motivation theory, in relation to participants’ progress in this protocol. Health models and various constructs of motivation were correlated to each other, weight loss, and improved blood analysis scores.

**Literature Review**

The review of literature was important to understand application of health models as the researchers designed weight loss protocol questionnaires. Three models were chosen that are applicable to the health behaviors of diet and exercise. Motivation theory is commonly associated with athletes and their performance. Hochbaum and Rosenstock’s HBM was originally used to impact a population by guiding them to see the importance of performing a health related action and achieving follow-through on that action. Prochaska’s TTM Stages of Change is frequently used in interventions to modify behavior based on the stage the person begins at and stages they need to move through to achieve an action.

*Motivation theory.* Traditionally, motivation theory is based on intrinsic and extrinsic motivation. With intrinsic motivation people participate for the sheer enjoyment of the activity itself. Extrinsic motivation leads to participation in response to a motivator separate from the activity itself. Current motivation theory focuses on the cognitive approach, where biology and environment may influence the behavior, but factors such as beliefs, emotions and self-efficacy are more responsible for an individual taking motivation to action (Dunsmore and Goodson, 2006, pg. 171). Dunsmore and Goodson’s metastudy (composed of 44 studies) found the most common indicators used to measure motivation were intention to act, and self-efficacy (pg. 174).

*HBM.* The HBM can be viewed as a cognitive motivation approach. There are two main premises for success of the HBM: the individual must feel their current health behavior is a threat and that a specific change will give a positive outcome at an acceptable cost (Glanz, Rimer, & Viswanath, 2008). This is termed value expectancy.

Outcomes using the HBM are based on the individual’s beliefs about six constructs in relation to their own health: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and later self-efficacy. Perceived susceptibility is related to one’s understanding they are in a risk group. This construct was found to be more important for those individuals who do not already have the disease by Janz and Becker (1984). Perceived severity is related to one’s understanding of the seriousness and consequences of a disease and was found to be a stronger construct for those who are already ill. One meta-analysis indicates “perceived barriers” has the highest significance of model constructs. Another later study indicates both benefits and barriers to be the strongest components of the model (Carpenter, 2010). Cues to action are reminders that support readiness. Self-efficacy is a construct in motivation theory and was recently added to HBM; it is a strong predictor to act as mentioned above under motivation theory. Generally, if benefits outweigh barriers and are supported by other constructs of the model, this will increase the individual’s likelihood to act.

*TTM.* The TTM is considered a primary model of behavior change (Glanz, Rimer, & Viswanath, 2008). There is research to both support and refute the efficacy of the TTM Stages of Change model. Research supporting the model was conducted by Marcus, Rossi, Selby, et al (1992), who stated that knowing the stage of readiness for exercise may inform one about their likelihood to adopt, adhere, or relapse. Glanz, Rimer, & Viswanath (2008) stated that pairing participants to an intervention appropriate to their stage of change yielded the best results.

Research that found fault with the model was conducted by Bridle and others from 2003-2010. Bridle (2005) states

Two distinct but inter-related issues may contribute to the lack of evidence regarding the effectiveness of interventions based on the TTM: (1) lack of model specification and (2) poor application. Regarding the former: although a central proposition of the model is that stage-specific processes of change enable people to overcome stage-specific barriers to change, the model fails to specify precisely the processes that relate to particular stages (Bridle, 2005, p. 296). Interventions in this review typically assessed stage of change at baseline, delivered an ill-defined and non-specific intervention, and then collected follow-up outcome data. Thus, most interventions were static and incomplete, being only partially tailored to only one point in time. It should be borne in mind that stage movement is a proxy measure of behavior change, and it should thus be regarded as a secondary rather than primary outcome, not least because stage progression does not necessarily equate ultimately to behavior change (Brindle, 2005, p. 297).

This criticism focuses on three points. First, the stage of change is usually identified only at the beginning of a study, as a baseline, so it is static. Second, the model itself does not specify the process related to the intervention/stage. Third, stage progression does not always translate to behavior change.

**Method**

**Program Components**

Program components included a protocol that each participant agreed to adhere to. That included completion of pre, post, and intermediate surveys, participation in exercise, participation in a diet/weight loss program, and pre and post blood analysis. Each participant was provided gym membership, weekly access to personal trainers, periodic weigh-in and support meetings, a monthly newsletter, and results of pre and post blood analysis. Services of a weight loss corporation were utilized the first two years and other professionals in health and nutrition fields were utilized Year Three.

**Research Objectives**

The specific research objectives of this portion of the study were to test each model separately:

a. How does the survey item which corresponds to the TTM compare to collective motivation score (MS)? How does it compare to HBM? How does the item compare to each of the progress variables?

b. How do items/questions which correspond to the HBM compare to the TTM, the MS?

c. The different variables used to represent motivation in pre-survey and midterm check-in sheet, were correlated to determine changes.

**Validity**

In order to test the validity of the study, researchers must show that study results support goals of the project. We used the correlation coefficient for statistical analysis. The correlation coefficient shows the relationship between two variables. Its value is between +1 and -1. Usually, a correlation of .01 to .25 is valued poor, .25 to .5 is moderate, .5 to .75 is good, and .75 to 1.0 is strong.

The following results were obtained:

1. During one mid-year study (two months into the study), correlation coefficients between MS to TTM and MS to HBM were calculated and it was found that the correlation coefficient between MS vs. TTM = 0.40 and between MS vs. HBM = 0.35. These correlation coefficients indicated moderate correlations. However, this correlation improved by Year Two (see #2 below).
2. Later, data were revised by scoring different values of questions G through M of initial data. At this time correlation coefficients between MS to TTM did not change (0.39) as compared to midyear report (0.40) but the correlation between MS to HBM showed significant improvement (0.66) as compared to midyear report (0.35). This evaluation shows that MS vs. HBM is a good predictor of the psychology for improvement.
3. Next, participant’s pre- and post- blood analysis was analyzed. In this case, a correlation coefficient of 0.78 was obtained between initial MS vs. change in blood level plot. This correlates strongly. The second plot was between change in blood level and TTM. This showed a correlation coefficient of 0.59 which is good. Blood analysis was significantly improved at the end of the program. So we conclude, blood analysis score change, which was found in a previous paper to be correlated with weight loss and exercise is now also found to be correlated with two of our models. (Wu, Edmondson, Whittle, Majid, Sistani, & Herring, 2016)
4. Researchers believed blood analysis results should be the most accurate indicator of program success. Indeed, among all of above tests, the blood analysis results show highest correlation results. This shows a positive success of this analysis.
5. As a part of the study, pre and post blood analysis was drawn from the participants and analyzed at the beginning and end of the project. Test-retest reliability could be performed. This result indicated a 94 to 97% reliability score**.** (Wu, Edmondson, Whittle, Majid, Sistani, & Herring, 2016)

**Assessment Methodology**

The research portion of the project used quantitative and qualitative methods to build data and determine efficacy of individuals and of the program (education and intervention). Pre-assessment measures were used to better understand the candidates. This allowed researchers to evaluate participant’s beginning physical state (blood analysis, BMI, fat measurement, etc.), their psychological state (including stage of change) and their social supports. Researchers also collected intermediate and post-intervention measures and information. The pre and post- test surveys were similar, but not the same. Many of the survey questions corresponded to a health model construct.

**Surveys**

Survey questions were constructed to assess goals and multiple supporting factors contributing to the individual’s success or failure to improve both health status and behaviors supporting health status. An additional factor was degree of readiness to change lifestyle, TTM.

Imbedded in the surveys were components corresponding to three health models in the form of questions. Components that corresponded to motivation theory included: willingness to exercise, willingness to change diet, defined goal or goals, current athletic status, and motivation level. These were analyzed separately, but also combined together into an overall MS.

*The over-all MS defined.* When participants signed up for the program they were asked a series of questions with either yes/no or Likert-scale response. These items’ point-values were summed, giving each person a score referred to as the MS. Some questions included are: what is your willingness to exercise 3-4 times a week; what is your willingness to modify your diet; what is your perception that you will be successful at achieving your goals; do you have support in your attempt to modify your behavior in regard to nutrition and exercise; how much time per week are you currently physically active; and do you reward yourself for success. For instance, we hypothesized for a beginning participant, the support of exercising with family or friends is more motivating than exercising alone, so we asked the participant to rank support on a Likert-scale of 1 to 5 where 1=low and 5=high.

HBM questions were based on the following 4 concepts: I know what to do and I believe the benefits outweigh the barriers (defined goal). I know how to do it (I have been provided the information). I have support (of friends and family). I will do it (confidence to be successful at exercise and diet change).

One question was used to determine the stage of the TTM that the participants placed themselves in. This was modeled in part from an item found on the UCLA Center for Human Nutrition (NA) website. This question was asked multiple times during the study: Which statement best describes where you are in changing your eating and exercise habits:

a. Until today I was not considering change. (Participants who choose this response were considered to be at the precontemplation stage of the model.)

b. I have mixed feelings about change, but will not change within the next month. (Participants who choose this response were considered to be at the contemplation stage of the model.)

c. I have some experience with trying to change and plan to act within 1 month. (Participants who choose this response were considered to be at the preparation stage of the model.)

d. I have been practicing the new behavior for 2-6 months. (Participants who choose this response were considered to be at the action stage of the model.)

e. I am trying to continue the healthy behaviors I started over 6 months ago. (Participants who choose this response were considered to be at the maintenance stage of the model.)

f. I was doing really well, but something changed and now I am back at \_\_\_\_ stage above. (This response corresponds to relapse to an earlier stage.)

**Data Analysis Results**

For this study, “progress” was defined as a change in knowledge, behavior, attitude, blood pressure, medication, MS, TTM Stage of Change, HBM and family and peer support for change. Progress also includes understanding daily calorie needs and calories in and calories out as it applied to each participant. Can we infer that the models contributed to physical progress?

In table 1, physical and psychological factors were compared to BMI change. TTM had a strong correlation to BMI Change (.93). Therefore, TTM was a good predictor of BMI change. The other good correlation in Year One show LDL (.69) and cholesterol (.54) changed with a person’s BMI change.

Table 1 goes here.

Table 2, the Year Two analysis, shows physical and psychological items with good to strong correlations. TTM was most strongly associated with individuals who identified they were exercising before beginning the program (.94), followed by those who indicated they had a goal (.62). HBM was most strongly associated with individuals who indicated a readiness to change diet and exercise behavior (.82), who also stated they will exercise (.8) and diet (.68), and perceived success (.72). MS was strongly correlated to change in blood level (.79) followed by a good correlation to the HBM (.66).

Table 2 goes here.

In Year Three, more data was collected; researchers added Basal Metabolic Rate and Percent Body Fat. Low correlation scores may indicate that percent body fat is difficult to change in the short term. Good to strong correlations of constructs to HBM were anticipate change (.95), will diet (.77), perceive success (.70), and ready to change (.59). Good correlations of constructs to TTM include will diet (.67), amount of exercise (.67), rewards (.56), and barriers identified (.51). MS had good correlation to constructs will diet (.66), will exercise (.58), and anticipate change (.55).

Table 3 goes here.

Table 4 included blood analysis from Year Three correlated to psychological and psychosocial factors. Glucose and HDL did not have a good to strong correlation to any of the psychological constructs. For these participants, glucose and HDL appear to be the most difficult of the blood scores to change. Cholesterol and LDL change are correlated to exercise (.69), rewards (.61), and support (.50). LDL change is positively correlated to beginning TTM (.63). Triglyceride change has a good correlation to attendance (.62), support of friends and family (.57), and the person has a goal (.54).

Table 4 goes here.

There existed a strong correlation between willingness to change versus reduced blood level scores and previous athletic status versus reduced blood level scores. These participants saw reduced total cholesterol, lower blood sugar, and LDL levels as well as higher HDL levels.

**Discussion**

We recognized from previous programs similar to ours that many behavioral factors had to be addressed, everything from lifestyle, culture, work schedules, social supports, determination, and more. We knew many of those factors were constructs of popular health models. So, how would attention to those details of health models during program implementation impact our degree of success?

As Bridle (2005) suggested, the TTM was not sufficiently specific to be a guide for programming. However, our results can shed some light regarding the use of the TTM as an indicator of success in a weight loss program. There were some consistencies between the individual identifying their personal construct stage on the TTM and their actual current athletic status. For instance, in Year Two the correlation between the Model and athletic status was strong (.94). Additionally, TTM had a good to strong positive correlation all three years to blood analysis score and/or BMI change. In our study surprisingly, the general category readiness to change was not a good correlation to TTM. Perhaps that was too broad a concept for our clients, as more specific statements of will diet, exercise, identify barriers, reward self, and set a goal had good correlations to this Model.

While the HBM had little correlation to the TTM in successive years (.19 and .02), HBM did have a good correlation to MS (.66 and .7). The connection between motivation and HBM was not surprising to the researchers as the concepts of belief to engage in or stop a behavior and self-efficacy were found in both the HBM and motivation theory. HBM correlated strongly to anticipated change. From our perspective consisting of literature and our current study, anticipated change is a defining construct of HBM. Interestingly in our study, HBM had good to strong correlations to a number of psychological constructs, but not to physical progress.

Although difficult to categorize and quantify, motivation plays a key role in performance at all levels of competition (McArdle, Katch & Katch, 2000). In our study, those participants with higher motivation said they will exercise, will diet, and anticipate change. There were consistent good correlations between MS and HBM. Though not as strong as the correlation between MS and HBM, there was a moderate correlation between MS and TTM.

**Conclusion**

In conclusion, those who recognized the need for change of both diet and exercise and were willing to dedicate their efforts toward those two goals were the ones that achieved the most success. From the perspective of the three models, motivation, HBM, and TTM, we saw many important factors improve to varying degrees physical and/or psychological progress of people who want to reverse obesity.

Each model we incorporated into our program had a different focus and impact. TTM correlated strongly with physical success. Those with previous athletic status were identified as successful by this model. Specific behavioral constructs produced better outcomes than broad ones. It would be worthwhile in future studies to check the TTM stage of change at various times beyond the start of the program.

HBM correlated with a number of behavioral constructs, but did not have a strong correlation with physical success. Clients were psychologically committed to change. The program provided education and personal trainers so they should have the knowledge. Participants reported family supports were somewhat low. The failure according to this model is lack of efficacy; our work did not translate to the actual performance of the actions on the part of some clients.

MS did have some good correlations to both physical and psychological constructs. Clients with high MS were more likely to work toward setting and achieving goals related to exercise and diet.

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Table 1: Year One analysis.

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Vs. Variable | Correlation  Coefficient | Value |
| HDL Change | BMI Change | 0.09 | Poor |
| Triglyceride Change | BMI Change | 0.32 | Moderate |
| MS | BMI Change | 0.40 | Moderate |
| Cholesterol Change | BMI Change | 0.54 | Good |
| LDL Change | BMI Change | 0.69 | Good |
| TTM | BMI Change | 0.93 | Strong |

Table 2: Year Two analysis

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Vs. Variable | Correlation Coefficient | Value |
| Will exercise | MS | 0.50 | Good |
| TTM | Change in Blood Level | 0.59 | Good |
| Goal | TTM | 0.62 | Good |
| MS | HBM | 0.66 | Good |
| Will diet | HBM | 0.68 | Good |
| Perceive Success | HBM | 0.72 | Good |
| MS | Change in Blood Level | 0.79 | Strong |
| Will exercise | HBM | 0.80 | Strong |
| Ready to Change | HBM | 0.82 | Strong |
| Athletic Status | TTM | 0.94 | Strong |

Table 3: Year Three analysis: Physical and psychological factors & three models

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| variable | BMR | PBF | attendance | HBM | TTM | MS |
| ready to change | 0.07 | 0.20 | 0.40 | 0.59 | 0.11 | 0.10 |
| will exercise | 0.14 | 0.48 | 0.29 | 0.49 | 0.20 | 0.58 |
| will diet | 0.31 | 0.20 | 0.14 | 0.77 | 0.67 | 0.66 |
| perceive success | 0.17 | 0.02 | 0.18 | 0.70 | 0.25 | 0.02 |
| support | 0.08 | 0.49 | 0.26 | 0.39 | 0.22 | 0.47 |
| anticipate change | 0.28 | 0.12 | 0.06 | 0.95 | 0.03 | 0.55 |
| exercise | 0.10 | 0.11 | 0.47 | 0.24 | 0.67 | 0.44 |
| has goal | 0.59 | 0.22 | 0.68 | 0.26 | 0.27 | 0.26 |
| barriers i.d. | 0.55 | 0.26 | 0.47 | 0.11 | 0.51 | 0.20 |
| rewards | 0.25 | 0.16 | 0.04 | 0.33 | 0.56 | 0.37 |
| attendance | 0.31 | 0.18 | 1.00 | 0.19 | 0.06 | 0.15 |
| HBM | 0.37 | 0.05 | 0.19 | 1.00 | 0.02 | 0.70 |
| TTM | 0.30 | 0.31 | 0.06 | 0.02 | 1.00 | 0.37 |
| MS | 0.09 | 0.08 | 0.15 | 0.70 | 0.37 | 1.00 |

BMR=Basil Metabolic Rate. PBF=Percent Body Fat.

Table 4: Blood Analysis from Year Three

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| variable | glucose change | triglyceride change | cholesterol change | HDL Change | LDL change |
| ready to change | 0.18 | 0.24 | 0.14 | 0.38 | 0.27 |
| will exercise | 0.30 | 0.49 | 0.29 | 0.11 | 0.33 |
| will diet | 0.41 | 0.09 | 0.33 | 0.13 | 0.49 |
| perceive success | 0.11 | 0.22 | 0.22 | 0.32 | 0.51 |
| support | 0.25 | 0.57 | 0.50 | 0.04 | 0.45 |
| anticipate change | 0.07 | 0.11 | 0.00 | 0.25 | 0.25 |
| exercise | 0.03 | 0.39 | 0.69 | 0.38 | 0.05 |
| has goal | 0.09 | 0.54 | 0.29 | 0.39 | 0.01 |
| barriers i.d. | 0.16 | 0.01 | 0.19 | 0.38 | 0.43 |
| rewards | 0.39 | 0.12 | 0.02 | 0.28 | 0.61 |
| attendance | 0.29 | 0.62 | 0.56 | 0.12 | 0.32 |
| HBM | 0.10 | 0.16 | 0.04 | 0.24 | 0.12 |
| TTM | 0.18 | 0.15 | 0.08 | 0.23 | 0.63 |
| MS | 0.01 | 0.32 | 0.08 | 0.17 | 0.14 |