Influence of Self-Efficacy on Health Behaviors Among Women with Overweight and Obesity during the COVID-19 Pandemic

Undergraduate Research Thesis

Presented in partial fulfillment of the requirements for graduation with *honors research distinction* in Psychology in the undergraduate colleges of The Ohio State University

by

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May 2022

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Abstract

This study was designed to evaluate the relationship between self-efficacy and health behavior change during the COVID-19 pandemic. Specifically, self-efficacy was evaluated as a variable that could be positively related to health-promoting behaviors in adults with overweight and obesity. Data were collected via an online self-report survey of 250 women, over the age of 18, with a Body Mass Index (BMI) greater or equal to 25, indicating overweight or obese status. The survey included multiple self-report measures providing evaluation of eating self-efficacy, exercise self-efficacy, COVID-19 impact, coping strategies, and diet and exercise behavior. Qualitative data regarding health behavior (exercise and diet) was coded to reflect the degree of change during the prior three months. Analyses indicated that eating self-efficacy was not correlated with diet behavior change (r=0.057, p=0.370), but increased exercise self-efficacy was correlated with increased exercise behavior (r=0.235, p<0.002). Also, BMI moderated the relationship between eating self-efficacy and three-month weight change, indicating the positive relationship between eating self-efficacy and weight loss was greater among women with higher BMI (t=-2.24, p=0.026). These findings imply that higher exercise self-efficacy beliefs were associated with positive behavior change despite the negative effects of the pandemic, especially among women with higher BMI. Further investigations exploring factors contributing to enhanced self-efficacy could help to establish the potential success of interventions targeting health-promoting behaviors among those with obesity.

Introduction

The COVID-19 pandemic, caused by the SARS-CoV-2 respiratory virus (Gorbalenya et al., 2020), has presented current generations with a world-wide public health crisis unlike anything we have previously experienced. In order to control the spread of COVID-19, many aspects of day-to-day life have dramatically changed. Many individuals started and have continued to work remotely or have lost their jobs due to government shutdowns and other pandemic restrictions (Dey & Lowenstein, 2020). The COVID-19 pandemic has wide-reaching implications and consequences—resulting from social and behavioral restrictions—particularly on our day-to-day lifestyle and routines. Social and behavioral restrictions associated with the pandemic presented the opportunity for positive improvements in health behaviors (e.g., healthy dietary choices and regular exercise), or conditions that allowed health behaviors to suffer. For certain populations, preserving or improving health behaviors are of particular importance for psychological (Carraça et al., 2021) and physical health ("Healthy Weight", 2021).

Isolation, quarantines, and social and behavioral restrictions are stressful events, which can have behavioral and psychological costs. The COVID-19 pandemic has increased the prevalence of stress, anxiety, and depression across the globe (Shah, et al., 2021), which demonstrates the psychological burden experienced by individuals beyond those who are directly combatting the pandemic (e.g., frontline health workers). As the pandemic has progressed, more literature has been published exploring the impact of the pandemic on health behaviors in the greater population, but little literature focuses on traits that have promoted health behaviors (Flanagan et al., 2021).

Populations at Risk

Individuals with obesity are at an increased risk for potential negative changes in health-promoting behaviors during the COVID-19 pandemic, due to pre-existing, non-pandemic related risk factors. Obesity itself has been classified as a pandemic (Meldrum et al., 2017), so understanding the impact of social and behavioral restrictions amidst the COVID-19 pandemic for individuals with overweight and obesity should be of high importance (Hall, Laddu, Phillips, Lavie, & Arena, 2020). The pandemic of obesity has been slowly developing for years and has been a growing concern for health care professionals and researchers (Hall, Laddu, Phillips, Lavie, & Arena, 2020). The National Center for Chronic Disease Prevention and Health Promotion warns that a lack of physical activity, which is linked to obesity (U.S. Centers for Disease Control, 2016), increases the risk of heart disease, Type II diabetes, and cancer (National Center for Chronic Disease Prevention and Health Promotion 2019). Thus, it is critical to understand the compounding effect that the COVID-19 pandemic might have on individuals with overweight and obesity, especially on their health-promoting behaviors.

Women are another group who were at an increased risk during the COVID-19 pandemic. Females were identified as having a higher risk for stress exposure due to COVID-19 (Park et al., 2020), and the Kaiser Family Foundation reports that women are more likely to experience mental health effects due to worry from the Coronavirus (Frederiksen et al., 2020). Women with obesity are at higher risk from suffering both physical and mental health consequences due to negative behavioral changes during the COVID-19 pandemic. Thus, evaluating potential traits that offer a protective or health-promoting benefit for health behaviors among women with overweight and obesity is of particular importance.

Risks and Opportunities for Change in Exercise Behavior Presented by the COVID-19 Pandemic

Public health efforts to reduce the spread of COVID-19, including government restrictions, lockdowns, and stay-at-home orders presented barriers, both perceived and actual, for individuals to continue an active lifestyle, which increased the likelihood of sedentary behavior (Hall, Laddu, Phillips, Lavie, & Arena, 2020). Even if individuals had access to means for exercise activity, the perception of exercise being more difficult or inaccessible reduced the frequency of physical activity (Herazo-Beltrán et al., 2017). The United States Centers for Disease Control and Prevention noted that many communities in the United States are not designed to promote physical activity, which is a general public health concern (National Center for Chronic Disease Prevention and Health Promotion, 2019). Communities that do have public parks available might not have had access to them due to government restrictions, resulting in further interruption of routines and limitation of resources (Dunton et al., 2020). Barriers presented by community construction, the closure of recreation facilities, gyms, and parks might have been a factor contributing to the inaccessibility of exercise, or at least presented the notion that exercise was inaccessible, particularly during lockdown periods.

While the COVID-19 pandemic presented barriers to engaging in exercise, it could have also created more free time for individuals. Having more free time may have created an opportunity for some individuals to increase, rather than decrease, the frequency of their exercise behavior. Although this opportunity existed, Flanagan et al. found that physical activity decreased, and sedentary activity increased during the COVID-19 pandemic (Flanagan et al., 2021).

Risks and Opportunities for Change in Diet Behavior Presented by the COVID-19 Pandemic

Dietary patterns such as high calorie, high cholesterol, or foods high in saturated fats, contribute to the development of obesity (National Center for Chronic Disease Prevention and Health Promotion, 2019), so understanding the influence of the COVID-19 pandemic on unhealthy eating behaviors is important. Economic status contributes to eating behavior, and potentially exaggerates predisposition of at-risk groups to engage in unhealthy eating due to the COVID-19 pandemic. Poverty has been associated with a high energy density diet (Alkerwi et al., 2015), and poverty has increased due to the COVID-19 pandemic, even after government assistance was distributed (Parolin et al., 2020). In 2012 Pan et al. assessed the relationship between food insecurity and obesity in a sample of 66,553 adults from 12 states in the United States (Pan et al., 2012). They found that food insecure adults had a 32% increased risk of being obese compared to food secure adults. The significant increase in likelihood of obesity in food insecure adults is thought to be related to the poor access to healthy foods and reliance on inexpensive calorie dense foods. Food insecurity has increased due to the COVID-19 pandemic (Hall et al., 2021), so it is possible poorer quality foods, which can contribute to obesity, are being consumed more frequently by more adults.

A study published in 2020 examined the relationship between patronage to unhealthy restaurant establishments in communities and obesity. The study concluded that communities with a higher percentage of individuals with obesity see higher patronage of unhealthy eating establishments, and the disparity increased during the COVID-19 pandemic (Ashby, 2020). These findings are important due to the evidence which confirms an increased risk for the population with obesity to make unhealthy diet choices, and this risk worsened during the COVID-19 pandemic.

However, the closure of restaurants and bars during lock-down periods could have promoted home cooking—which has been associated with a reduced amount of fat and sugar consumption (Wolfson & Bleich, 2015)—potentially leading to an increase in positive dietary choices. Flanagan et al. 2021 did find a significant reduction in the number of meals purchased from restaurant establishments and a significant increase in home cooked meals during the COVID-19 pandemic. Due to the social behavioral factors previously described and economic factors, positive dietary habits are at risk because of COVID-19, but there is also a possibility for improvements in dietary behavior to occur.

Self-efficacy and Health Behavior

Self-efficacy is defined as an individual's belief in their ability to execute the behaviors necessary to achieve a goal (Bandurra, 1977). Higher self-efficacy is associated with a greater likelihood of engaging in a behavior, and self-efficacy is a predictor of how much effort will be invested in a task and how long behaviors will be maintained in the presence of obstacles or challenges (Bandura, 1977). In the face of barriers to engaging in a behavior, like health-promoting behaviors, self-efficacy is important. (Bandura, 1997).

Self-efficacy has been a predictor of greater weight-loss and engagement in diet and exercise behaviors (Pelletier, Dion, Slovinec-D'angelo, & Reid, 2004). Higher levels of self-efficacy have also been correlated with a reduction of negative nutritional behaviors and emotional habitual eating (Sekula et al., 2019). Self-efficacy has been identified as a significant predictor of increased physical activity, even when controlling for biological and other behavioral factors (McAuley, 1993). Self-efficacy has also been identified as an important predictor for physical activity for individuals with overweight and obesity (Robertson et al., 2020). Nezami and Robertson conducted a randomized physical activity intervention study in

2016 that assessed the association of both eating and exercise self-efficacy, respectively, with weight loss. Their research demonstrated that eating self-efficacy and physical activity self-efficacy predicted weight loss for both physical activity intervention conditions included in their study (Nezami & Robertson, 2016). This evidence suggests that self-efficacy is a meaningful predictor for both exercise and eating behaviors.

Greater self-efficacy helps an individual to view challenging tasks as opportunities rather than threats (Bandura, 2012). The nature of self-efficacy as a belief system, that may promote behavior in the face of challenges and allow individuals to view challenging circumstances as opportunities, is especially relevant in the scenario of the COVID-19 pandemic. Although there are multiple barriers in the domains of diet and exercise amidst the pandemic, with the potential to limit health-promoting behaviors, self-efficacy could potentially serve as a protective factor, that could help individuals overcome obstacles related to a specific task.

Present Research

As the COVID-19 pandemic has progressed, many studies have been published examining the impact of the pandemic on health-promoting behaviors, including studies of individuals with overweight and obesity. Studies like the Flanagan et al. study have established that the health behaviors of the overweight and obese have the potential to improve and or suffer during the COVID-19 pandemic. Other work also has confirmed that there are longitudinal consequences to the disruptions caused by the COVID-19 pandemic for weight management, which is particularly important individuals with obesity (Bhutani et al., 2021). However, prior studies have not explored potential protective individual differences, that could allow for improvement during the COVID-19 pandemic rather than the deterioration of health-promoting behaviors.

Because self-efficacy is associated with positive health behaviors (exercise and diet), understanding influences of self-efficacy in the context of the pandemic is relevant. As previously established, females are at a higher risk for stress as a result of the COVID-19 pandemic, and greater stress is related to negative changes in health-promoting behaviors (Stults-Kolehmainen & Sinha, 2014). Because women with overweight and obesity are population are at an increased risk for experiencing negative effects due to the pandemic, it is a meaningful endeavor to explore effects of self-efficacy in an at-risk population.

This study aimed to assess the relationship of self-efficacy to changes in diet and exercise behavior, which will allow for an initial evaluation of self-efficacy as a potential protective factor for health behavior during the COVID-19 pandemic. To assess the research questions of this study, the primary hypotheses were as follows: higher eating self-efficacy in women with overweight and obesity will be related to positive changes in diet behaviors throughout the COVID-19 pandemic; higher exercise self-efficacy will be related to positive changes in exercise behaviors throughout the COVID-19 pandemic; self-efficacy will be positively correlated with quantitative measures of health promoting behavior; eating and exercise self-efficacy will be correlated with a quantitative health behavior outcome—three-month weight change; age, race, and BMI may serve as moderators for the relationships between self-efficacy and diet and exercise change.

Materials and Method

The data utilized in this study were collected for a larger project titled “Health Behaviors and General Well-Being among Women amidst COVID-19.” The purpose of the parent study was to assess the impact of the COVID-19 pandemic among individuals with chronic health

problems (e.g., obesity) and individuals belonging to minority groups who are subject to discrimination in their daily life.

Participants

A statistical power analysis was performed to establish the needed *N* for the "Health Behaviors and General Well-Being among Women amidst COVID-19" study. The effect size was *r*= -0.20 with an alpha = 0.05, power = 0.80, and these analyses indicated a sample size of *N*= 200. Using the online recruitment tools ResearchMatch and StudySearch and offline via flyers, 250 women with overweight and obesity above the age of 18 were recruited. Recruitment was extended beyond the needed number of participants determined by the power analysis to ensure representative participation among under-represented groups. Overweight and obese status was determined using Body Mass Index (BMI). During recruitment, potential participants were asked their height and weight to calculate BMI and ensure that the BMI was 25 or higher. If BMI was less than 25, the participant was not allowed to continue with the survey. All participants were compensated with a $15 electronic gift card after they completed the single-session questionnaire.

Descriptive analyses of demographic data were conducted to describe the sample of 250 women with overweight and obesity. The mean age in the sample was 43.9 years with a standard deviation (SD) of 14.9 years, a range of 18-82 years, and an interquartile range (IQR) of 32-54 years. The mean BMI was within the obese range, (M=31.9, SD=5.9, Range=25.1-56.1, and IQR=27-35), but the BMI of participants ranged from overweight to extremely obese. The percentages of individuals from each respective racial group were as follows: 62.4% white (58.8% of white participants were non-Hispanic white), 14.4% Black, 18% Asian, 5.2% Multiracial, and 0.4% American Indian/Alaskan Native. 6.8% of participants identified they

were of Hispanic descent and also belonged to the following racial groups in the following percentages: 52.9% White, 23.5% Black, 11.8% Multiracial, 5.9% American Indian/Alaskan Native, and 5.9% Asian. The participants lived in the following locations at the time of data collection: 20% Columbus, Ohio or Columbus, Ohio Metropolitan Area, 10.8% Ohio (not Columbus), 10.8% Midwestern states (not including Ohio), 16.8% Northeastern United States, 30% Southeastern United States, 0.4% Southwestern United States, 10% Western United States, and 1.2% of participants were located outside of the United States.

Procedure

After recruitment, participants completed an online survey via Qualtrics. The survey was distributed to participants via email, and it was completed independently. The survey was completed in one session requiring approximately one hour. The survey included multiple self-report questionnaires which were selected to assess a range of variables relevant to physical and mental health for the "Health Behaviors and General Well-Being among Women amidst COVID-19" project. The nature of the relevant questionnaires for the present study are discussed in detail below. When the survey was completed, participants were provided with a thank you message and instructions for accessing their payment.

Measures

For the current study, the variables of interest included eating and exercise self-efficacy, coping mechanisms, the impact of the COVID-19 pandemic, current health behaviors (diet and exercise), and reported weight change during the prior three months. The questionnaires selected to assess these variables include the Eating Self-Efficacy Scale (ESES; Glynn & Rudderman, 1986), the Exercise Self-Efficacy Scale (EXSE; McAuley, 1993), the Brief COPE (Carver, 1997), the COVID-19 Exposure and Family Impact Survey (CEFIS; Kazak et al., 2020), the

Modified Observing Protein & Energy Nutrition (OPEN) Multifactor Screener (Thompson et al., 2004), and the Modified International Physical Activity Questionnaire—Short Form (IPAQ-SF; Craig et al., 2003).

Eating Self-Efficacy Scale (ESES)

The ESES consists of 25 items, which utilize a 7-point (1= No difficulty controlling eating to 7= Most difficulty controlling eating). The 25 items assess how respondents feel regarding control of overeating in a range of scenarios. An example item is "How difficult is it to control your overeating when you feel restless?" (Glynn & Rudderman, 1986). Because of the scoring of the ESES, lower scores indicate higher eating self-efficacy, and high scores indicate low eating self-efficacy.

Exercise Self-Efficacy Scale (EXSE)

The EXSE consists of 16 items, which allow participants to respond using a percentage scale that ranges from 0% (I cannot do it at all) to 100% (certain that I can do it). The 16 items present certain barriers to completing exercise, such as "I could exercise when feeling depressed" (McAuley, 1993).

Brief COPE

The Brief COPE questionnaire consists of 28 items that measure the utilization of 14 coping strategies by respondents. The coping strategies include active planning, positive reframing, acceptance, humor, religion, emotional support, instrumental support, self-distraction, denial, venting, substance use, behavioral disengagement, and self-blame. The respondent indicates use of each of the 14 coping strategies (e.g., "I've been making jokes about it") indicates on a 4-point Likert scale to answer that ranging from 1= I usually don't do this at all to 4 = I usually do this a lot (Carver, 1997).

COVID-19 Exposure and Family Impact Survey (CEFIS)

The CEFIS assesses the respondent's individual and family exposure to COVID-19. The questionnaire is composed of three parts, which have three different formats. The first part is a series of "yes" or "no" and open-ended questions. An example question from Part One of the questionnaire is "We had to move out of our home." Part Two uses a 5-point Likert scale which ranges from 0= non-applicable to 4= Made a lot worse, and an example prompt is "Your physical wellbeing—sleeping." Part three consists of open-ended, free response questions that allow respondents to describe the positive and negative effects of the COVID-19 pandemic for them individually and their family (Kazak et al., 2020). This questionnaire is used to indicate the extent to which a respondent was impacted by the pandemic.

Modified Observing Protein & Energy Nutrition (OPEN) Multifactor Screener

The OPEN Multifactor Screener consists of 18 items that assess the consumption of fruit and vegetables typically consumed by a respondent, the percentage of energy intake from fat in a respondent's diet, and the amount of fiber consumed in the respondent's diet. Respondents indicate how often they consume a specific food using a 9-point Likert scale that ranges from "Never" to "4 or more times per day." An example item is "How often do you eat hot dogs made of beef or pork?" The questionnaire also includes an open-ended item, which allows the respondent to describe specifics of their diet that they feel were not addressed by the scale (Thompson et al., 2004).

Modified International Physical Activity Questionnaire—Short Form (IPAQ-SF)

The IPAQ-SF consists of 8-items that determine the physical activity and inactivity performed by a respondent in the past seven days. The questionnaire asks respondents to report the amount of time they have engaged in vigorous exercise, moderate exercise, walking, and

sitting. Respondents are asked to report the number of days, hours per day, and minutes per day that they participated in these activities during the past seven days (Craig et al., 2003). For the "Health Behaviors and General Well-Being among Women amidst COVID-19" and the current study, a free response question was added to the IPAQ-SF to allow respondents to describe pandemic-specific activity patterns that they feel are relevant.

Three-Month Weight Change

Participants were given the following prompt as a part of the questionnaire survey: "Please select the statement that best describes you. 'During the past 3 months my weight has…'" The prompt was followed by options to indicate "Decreased 10 lbs. or more, "Decreased by 5-10 lbs." "Been relatively stable" "Increased by more than 10 lbs. or more" or "I am not sure." For analyses, responses of weight decreasing by any amount was assigned a code of 1, and all other responses a code of zero.

Coding of Qualitative Data

Participants were asked whether their dietary and exercise behavior had changed since the stay-at-home orders in March of 2020. Those who answered "Yes" acknowledging that there was a change in their eating and/or exercise behavior, were then able to provide an extended response. The free response data were then coded and categorized as a "Positive Change," "Negative Change," or "No Change," For statistical analysis purposes, "Positive Change" was assigned a 1, and "Negative" and "No Change" were assigned 0. Assigning the quantitative code allowed for quantitative analysis with the other operationalized variables of interest.

For diet, "Positive Change" was assigned when participants noted eating less frequently, eating smaller portions, or eating more nutritious food (e.g., fruits, vegetables, whole grains), reducing intake of calorie-dense foods and drinks (e.g., desserts, processed snacks, processed

carbohydrates, soda), or eating meals prepared at home. “Negative Change” was assigned when participants noted eating more frequently, eating more calorie dense foods, eating few nutritious foods, eating more processed foods, and or eating more meals prepared by restaurants, grocery stores, or another source outside the home. One dietary response was not related to health behavior change and was excluded from analyses.

For exercise, “Positive Change” was assigned when there was direct reference to a decrease in sedentary behavior or an increase in active behavior. “Negative Change” was assigned to responses that specifically referenced a decrease in active behaviors and an increase in sedentary behavior.

For both diet and exercise, “No Change” was assigned when there was no clear link between the COVID-19 pandemic and their response, changes were noted as insignificant, or changes were attributed to another cause (other than the COVID-19 pandemic).

Statistical Methods

SAS 9.4 software was employed for the statistical analysis of all variables. Correlation, regression, and chi-square analyses were completed to assess the primary and secondary hypotheses of the study. Correlational analyses were conducted first to begin the exploration of the hypothesized relationships between eating and exercise self-efficacy, coping skills, quantitative measures of health promoting behavior, COVID-19 impact, and diet and behavior change. The correlational analyses were followed by multiple regression analyses to predict eating and exercise self-efficacy, and logistic regression analyses were conducted to predict dichotomous variables (exercise change, diet change, and three-month weight change) and explore possible moderators. Both multiple and logistic regressions were conducted while controlling for potential confounds (age, race, and BMI). Age and BMI were entered as

continuous variables into the regression model while race was categorical. Respondents who were of non-Hispanic White ethnicity received a code of 0 and respondents of color received a code of 1. Thus, white respondents served as the reference group. Chi Square analyses were used to assess potential relationships between categorical variables. Regression analyses were also used to explore potential moderators through interaction analyses, which were then followed by post-hoc correlational analyses.

Results

Correlates of Coping Skills

Coping skills measured by the Brief COPE were initially investigated as a potential correlate of eating self-efficacy (ESES), exercise self-efficacy (EXSES), and health behavior change. EXSES correlated with the following coping strategies: Emotional (r=0.18, p<0.005), Instrumental (r=0.14, p=0.02), Disengagement (r=0.22, p<0.001), Reframing (r=0.14, p=0.03), Planning (r=0.19, p=0.003), and Religion (r=0.13, p=0.037). ESES was correlated with the following coping strategies: Distraction (r=0.13, p=0.036), Disengagement (r=-0.15, p=0.016), Reframing (r=-0.19, p=0.008), Acceptance (r=-0.17, p=0.007), and Blame (r=0.29, p<0.001). None of the coping strategies were significant predicators of diet or exercise behavior change. Due to the relatively low magnitude of correlations and the absence of a relationship of COPE scales to behavior change, further analyses regarding potential relationships between the coping dimensions and other variables of interest were not pursued.

Correlates of eating self-efficacy

Four of the OPEN Multifactor Screener questions were used as a quantitative measure of healthy dietary behavior, reflecting the amount of whole grain bread, fruit (not including juices), salad, and other vegetables consumed by a participant per day. Surprisingly, whole grain bread

(r=-0.018, p=0.781), fruit (r=-0.081, p=0.201), salad (r=-0.072, p=0.254), and other vegetable (r=-0.0501, p=-.423) consumption was not associated with eating self-efficacy (ESES).

To assess the impact of COVID-19 on eating self-efficacy in this sample, a correlation analysis was conducted between ESES and CEFIS Impact. There was a significant positive relationship (r=0.34, p<0.001), which indicates that greater impact of COVID-19 was associated with lower eating self-efficacy. This is an anticipated relationship because the stress of increasing impact of the COVID-19 pandemic would likely reduce eating self-efficacy.

Regression Analysis Predicting ESES

After completing the correlation analyses, Eating Self-Efficacy (ESES), was regressed onto Three-Month Weight Change, COVID-19 Impact (CEFIS Impact), and demographic factors of interest age, race, and BMI). As shown in Table 1, Three-Month Weight Change (t=-2.75, p=0.007), CEFIS Impact (t=4.57, p=<0.0001), age (t=-2.58, p=0.011), and BMI (t=2.07, p=0.04) were all significant predictors of ESES. The direction of the correlation between ESES and Three-Month Weight Change indicates that as eating self-efficacy declined, respondents were more likely to have experienced no change in weight or weight gain in the past three months. The correlation between ESES and CEFIS Impact suggests that those with higher impact scores were more likely to have lower eating self-efficacy. The correlation between ESES suggests that as BMI increases, eating self-efficacy decreases.

Correlates of exercise self-efficacy

To assess the relationship in this sample between exercise self-efficacy and a quantitative measure of total exercise, a correlation analysis of EXSES and total activity (collected via the IPAQ-SF questionnaire) was conducted. Total activity was positively correlated with EXSES (r=0.30, p<0.001). This correlation supports the expected relationship between exercise self-

efficacy and total activity because self-efficacy is theorized to directly impact the initiation of situation specific behaviors (Bandura, 1997). To evaluate the relationship between the impact of the COVID-19 pandemic and exercise self-efficacy, a correlation analysis was conducted with EXSES, and an impact measure derived from the CEFIS questionnaire. EXSES were significantly correlated with CEFIS Impact (r=0.147, p=0.021). The positive direction of the relationship between EXSES and CEFIS impact is surprising. The anticipated direction was negative because it was thought that as COVID-19 impact increased, exercise self-efficacy would decrease. EXSES and ESES were significantly correlated in this sample (r=-0.185, p=0.003). The negative direction of this relationship is expected due to lower numeric on the ESES representing higher eating self-efficacy, thus eating self-efficacy was associated with exercise self-efficacy.

Regression Analysis Predicting EXSES

After completing the correlation analyses, Exercise Self-Efficacy (EXSES) was regressed onto Eating Self-Efficacy (ESES), Three-Month Weight Change, COVID-19 Impact (CEFIS Impact), and demographic factors of interest (age, race, and BMI). As shown in Table 3, Three-Month Weight Change (t=3.29, p=0.001), CEFIS Impact (t=-2.80, p=0.006) and BMI (t=-2.90, p=0.005) were significant predictors of EXSES. Although ESES and EXSES are significantly correlated, ESES were not a significant predictor of EXSES.

Correlates of Diet and Exercise Change

EXSES was significantly correlated with the coded qualitative measure of exercise change (r=0.235, p=<0.001), but ESES was not significantly correlated with exercise change (r=0.03, p=0.661). As expected, higher exercise self-efficacy was associated with greater exercise behavior, but eating self-efficacy was not related to exercise behavior. Improved dietary

intake was correlated with EXSES (r=0.16, p=0.012), but not with ESES (r=-0.057, p=0.369). This was surprising since ESES was hypothesized to be correlated with diet change. Diet change and exercise change were correlated (r=0.18, p=0.005), suggesting that positive exercise changes were associated with positive diet changes. However, the magnitude of the correlation suggests that exercise and diet changes did not always occur together.

Regression Analysis Predicting Diet Change

As with Exercise Change, a regression analysis was completed to further evaluate the relationship between the independent variable of interest, Eating Self-Efficacy, and the dependent variable diet change while controlling for possible confounds. Diet change was regressed onto ESES while controlling EXSES, CEFIS, race, age, and BMI. As shown in Table 2, ESES was not a significant predictor of Diet Change (t=-1.60, p=0.112), and the analysis yielded no other significant predictors.

Regression Analysis Predicting Exercise Change

After the initial correlational analyses conducted exploring the relationships between exercise change and exercise self-efficacy, a regression analysis was used to control for potential confounds. Exercise change was regressed onto EXSES while controlling for ESES, CEFIS Impact, race, age, and BMI. As shown in Table 4, EXSES was a significant predictor of exercise change (t=2.66, p=0.009), while controlling for possible confounds. CEFIS Impact also remained a significant predictor while controlling for confounds (t=-2.66, p=0.009).

Correlates of Three-Month Weight Change

Multiple correlation analyses were conducted to evaluate the relationships of three-month weight change and variables of interest (exercise self-efficacy, eating self-efficacy, exercise change, and diet change). Three-month weight change was significantly correlated with Exercise

Change (r=0.189, p=0.004), and with diet change (r=0.43, p<0.001). Three-month weight change was significantly correlated with EXSES (r=0.202, p=0.002) and ESES (r=-0.196, p=0.003).

Regression Analyses Predicting Three-Month Weight Change

A regression analysis of three-month weight change was conducted controlling for potential confounding variables. As shown in Table 5, EXSES (t=3.19, p=0.0016) and ESES (t=-2.75, p=0.006) were both significant predictors of three-month weight change, while controlling for potential confounds.

Chi Square Analyses

To assess the relationships of the categorical variables, exercise change, diet change, and three-month weight change, Chi-Square analyses were completed. As shown in Table 6, the Chi-Square analysis of categories diet and exercise change revealed that the categories are significantly related to one another (Chi-Square (1, (N=249) = 44.35, p=<0.001). This result indicates that there is a significant relationship between participants who made positive exercise change and those who made positive diet change.

As shown in Table 6, the Chi Square analysis of three-month weight change and diet change revealed a statistically significant relationship (Chi Square (N=236) = 44.346, p<0.001). Losing weight was associated with positive diet changes.

As shown in Table 7, the Chi Square analysis of the three-month weight change and exercise change revealed that the two are statistically related to one another (Chi Square (N=237)= 8.47, p=0.004). This result indicated that there is a significant relationship between losing at least 5-10 lbs. in the last three months and making positive exercise changes.

Regression Analyses to Identify Potential Moderator

Age, COVID-19 Impact, race, and BMI are hypothesized moderators of the relationship between exercise self-efficacy (EXSES) and exercise change, as well as the relationship of eating self-efficacy (ESES) to diet change. Regression analyses were conducted to evaluate potential moderators age, race, and BMI as possible moderators of the relationship between self-efficacy and three-month weight change. The analyses indicated that age, race, and BMI did not moderate the relationship between EXSES and exercise change. Similarly, regression analyses indicated that age, race, and BMI did not moderate the relationship between EXSES and weight change.

As shown in Table 8, BMI moderated the relationship between ESES and three-month weight change. The interaction between BMI and ESES was significantly predictive of three-month weight change (t=-2.24, p=0.026). To determine the direction of the moderating effect, post-hoc correlational analyses were conducted. The post-hoc correlational analyses revealed that for individuals with overweight (BMI 25-30), the relationship was not statistically significant (r=-0.122, p=0.205). For individuals with obesity (BMI 30-40), the relationship was statistically significant (r=-0.255, p=0.008). For individuals with extreme obesity (BMI 40 and greater), the relationship was not statistically significant, but the magnitude of the correlation continued to increase (r=-0.375, p=-0.085). The post-hoc analyses confirmed BMI as a moderator of the relationship of Eating Self-Efficacy and Three-Month Weight, indicating that higher eating self-efficacy was associated with greater weight loss especially in the context of higher BMI.

Discussion

The goal of this study was to evaluate the relationship of exercise and eating self-efficacy to health-promoting behaviors, specifically exercise and diet, among women who were at heightened health risk due to their BMI and the presence of a global pandemic. Through

correlation, Chi-Square, and regression analyses, this goal was accomplished and revealed significant relationships between self-efficacy and health promoting behaviors in the context of the COVID-19 pandemic.

Exercise self-efficacy was a significant predictor of reported exercise behavior change. The study hypotheses predicted these results based on the established relationship between exercise self-efficacy and exercise behavior, but this study demonstrates that the relationship was undisturbed by the significant lifestyle and social changes created by the COVID-19 pandemic. Within the study sample, there was a significant relationship between exercise self-efficacy and total physical activity, demonstrating the hypothesized relationship between exercise self-efficacy and a quantitative measure of exercise. Contrary to the anticipated relationship between exercise self-efficacy and the COVID-19 pandemic, there was a significant positive relationship between CEFIS impact and exercise self-efficacy. It was anticipated that as CEFIS impact increased, exercise self-efficacy would decrease, but the results indicated the opposite. Regarding BMI, the significant negative relationship between BMI and EXSES was expected because lower self-efficacy has previously been demonstrated to be related to high BMI (Bagherniya, 2018). Exercise self-efficacy was a significant predictor of three-month weight change, which is also an important confirmation of the hypothesized relationship between exercise self-efficacy and a health behavior outcome. Because individuals with overweight and obesity are at a higher risk from suffering deterioration of exercise behaviors during the pandemic, confirming that Exercise Self-Efficacy is a construct that seems to support the continuation and promotion of exercise behavior was important.

Eating self-efficacy proved to contradict the hypothesized relationships with diet change and with quantitative measures of healthy dietary choices. Eating self-efficacy was not a

significant predictor of diet change or of consumption of whole grain bread, fruit, salads, or other vegetables. The negative relationship seen in the regression analysis predicting ESES revealed CEFIS Impact as a significant negative predictor of eating self-efficacy, which indicates higher eating self-efficacy was associated with higher COVID-19 Impact. This was a surprising finding, but it mirrors the correlation between exercise self-efficacy and COVID-19 Impact, which followed the same pattern. Although eating self-efficacy was not predictive of diet change, higher eating self-efficacy was predictive of weight loss, which is an important outcome for individuals with overweight and obesity. Higher eating self-efficacy was associated with weight loss, and the moderating influence of BMI identified that the relationship between eating self-efficacy and weight loss was stronger as BMI increased. Because this relationship was stronger as BMI increased, the relationship could imply that eating self-efficacy is a particularly important construct for individuals with obesity and extreme obesity who are attempting to lose weight.

The current results indicated no significant relationship between eating self-efficacy and positive diet change. The significant relationship between eating self-efficacy and three-month weight change indicates that those with higher eating self-efficacy were likely to have experienced at least five or more pounds of weight loss during the pandemic. Thus, it seems eating self-efficacy was relevant for weight loss, but not specifically for positive dietary change, which seemingly were not necessarily synonymous. Nevertheless, further investigation of protective constructs besides eating self-efficacy for positive diet change may be warranted, due to the importance of a healthy diet for the population with overweight and obesity.

The self-report and correlational nature of this study limits the concrete implications of its findings. Further research is required to provide further support to strengthen the evidence for

the validity of the relationship between eating and exercise self-efficacy with diet and exercise change and weight change outcomes. This study had enough participants to exceed the needed effect size for adequate statistical power, but a larger scale study would have allowed for further exploration of correlational trends, according to age and BMI. Individuals in late adulthood and individuals with extreme obesity were minorities in this sample, so statistical power was lost when assessing age and BMI trends. Because of the greater risks experienced by women due to the COVID-19 pandemic, women were selected for this study. However, that choice limits the generalizability of these findings. Male sex is a constitutional factor that puts men at risk for the development of obesity-related disease, so future research examining the value of eating and exercise self-efficacy for males is important and relevant.

Self-report research is always subject to the risk of self-report bias, but social desirability bias is of particular concern when discussing health behaviors. A study published by Hebert et al. in 1995 established that dietary self-report measures are subject to a downward bias due to social desirability bias, and this was particularly true for women (Hebert et al., 1995). Similar research was conducted by Motl et al. in 2005 evaluating the influence of social desirability associated with self-reported physical activity but found that the influence of social desirability was minimal (Motl et al., 2005). All scales used in this study have been tested for validity, but it is worth noting the potential biases that might exist in self-report data. The coding of qualitative data regarding diet and exercise change allowed respondents to provide more information about the specifics of their behavior changes, but subjectivity regarding these changes could have been reduced by including an objective measure.

The current research found results echoing the results of the Nezami and Robertson intervention study, but these data on eating self-efficacy and exercise self-efficacy on weight

change were collected in a self-report study format, amidst the COVID-19 pandemic. The current findings of the study appear to support the relevance of exercise and eating self-efficacy for weight change in the new reality of the COVID-19 pandemic, thus warranting further exploration in an intervention format. The current results may demonstrate that despite large barriers to maintaining a healthy diet and exercise behaviors, self-efficacy in each respective context allowed individuals to make positive weight changes despite the pandemic.

The COVID-19 pandemic presented the opportunity to evaluate the relationship of eating and exercise self-efficacy with health behavior and weight change outcomes when participants were experiencing context-imposed boundaries and stress. Eating and exercise self-efficacy were associated with positive health behavior outcomes, suggesting that self-efficacy played a role in the ability of women to use the pandemic as an opportunity for change, rather than succumbing to health behavior deterioration, which was made much more likely due to the pandemic. The correlational nature of these results prevents causal conclusions but suggest opportunities for future intervention or experimental research to establish causal links.

Conducting future research evaluating the relationship of self-efficacy and health-promoting behaviors is of high importance. As the COVID-19 pandemic loosens its grasp on the world and our everyday lives, the pandemic of obesity persists. Hopefully, there are few infectious disease pandemics in our future, but the identification of the beneficial nature of self-efficacy for health behaviors under stress could prove relevant in more normative life contexts. Stressful events related to an individual's personal life, for example, could create barriers or limit engagement in health-promoting behaviors, so the value of interventions promoting eating and exercise self-efficacy is not unique to COVID-19. Public health interventions to combat obesity and improve population health could benefit from incorporating strategies to strengthen eating

and exercise self-efficacy to promote the resiliency of health-promoting behaviors in the face of barriers.

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Tables

Table 1: Multiple Linear Regression Analysis (Full Model)—Predicting Eating Self-Efficacy (ESES)

Variable	DF	Parameter Estimate	Standard Error	*t* Value	*p* Value
EXSES	1	-0.07238	0.09247	-0.78	0.4346
Three-month weight change	1	-13.60404	4.94545	-2.75	0.0064
CEFIS Impact	1	1.10487	0.24193	4.57	<0.0001
Race	1	-2.56664	4.29994	-0.60	0.5512
Age	1	-0.36334	0.14106	-2.58	0.0106
BMI	1	0.71666	0.34565	2.07	0.0393

Table 2: Logistic Regression Analysis (Full Model)—Predicting Diet Change (self-reported changes regarding the previous three months)

Variable	DF	Parameter Estimate	Standard Error	*t* Value	*p* Value
EXSES	1	0.00408	0.00224	1.82	0.0719
ESES	1	-0.00230	0.00143	-1.60	0.1121
CEFIS Impact	1	-0.00335	0.00559	-0.60	0.5495
Race	1	-0.03218	0.09996	-0.32	0.7482
Age	1	0.00473	0.00332	1.42	0.1573
BMI	1	0.00326	0.00787	0.41	0.6798

Table 3: Multiple Linear Regression Analysis (Full Model)—Predicting Exercise Self-Efficacy (EXSES)

Variable	DF	Parameter Estimate	Standard Error	*t* Value	*p* Value
ESES	1	-0.03094	0.04678	-0.66	0.5091
Three-month weight change	1	11.49891	3.49119	3.29	0.0011
CEFIS Impact	1	-0.49405	0.17665	-2.80	0.0056
Race	1	-3.23079	3.04503	-1.06	0.2898
Age	1	-0.12999	0.10113	-1.29	0.2000
BMI	1	-0.69669	0.24296	-2.87	0.0045

Table 4: Logistic Regression Analysis (Full Model)—Predicting Exercise Change (self-reported regarding the previous three months)

Variable	DF	Parameter Estimate	Standard Error	*t* Value	*p* Value
EXSES	1	0.00368	0.00138	2.66	0.0086
ESES	1	0.00137	0.00091200	1.50	0.1361
CEFIS Impact	1	-0.00958	0.00360	-2.66	0.0087
Race	1	-0.05067	0.05981	-0.85	0.3982
Age	1	-0.00019607	0.00195	-0.10	0.9200
BMI	1	-0.00559	0.00466	-1.20	0.2316

Table 5: Logistic Regression Analysis Full Model—Predicting Three-Month Weight Change (self-reported regarding the previous three months)

Variable	DF	Parameter Estimate	Standard Error	*t* Value	*p* Value
EXSES	1	0.00379	0.00119	3.19	0.0016
ESES	1	-0.00234	0.00085115	-2.75	0.0064
CEFIS Impact	1	0.00396	0.00330	1.20	0.2323
Race	1	0.01485	0.05645	0.026	0.7928
Age	1	0.00207	0.00187	1.11	0.2699
BMI	1	0.00697	0.00455	1.53	0.1274

Table 5: Chi-Square Analysis—Exercise Change and Diet Change (*N*=249)

Exercise Change	Diet Change		
	0	1	Total
0			
Frequency Percent Row Percent Col Percent	192 77.11 85.71 92.31	32 12.85 14.29 78.05	224 89.96
1			
Frequency Percent Row Percent Col Percent	16 6.43 64.00 7.69	9 3.61 36.00 21.95	25 10.04
Total Percent	208 83.53	41 16.47	249 100.00
Statistic	DF	Value	Probability
Chi-Square	1	44.3458	<0.0001

Table 6: Chi-Square Analysis—Three-Month Weight Change and Diet Change (*N*=236)

Weight Change	Diet Change		
	0	1	Total
0			
Frequency	168	15	183
Percent	71.19	6.36	77.54
Row Percent	91.80	8.20	
Col Percent	85.71	37.50	
1			
Frequency	28	25	53
Percent	11.86	10.59	22.46
Row Percent	52.83	47.17	
Col Percent	14.29	62.50	
Total Frequency	196	40	236
Percent	83.05	16.95	100.00

Statistic	DF	Value	Probability
Chi-Square	1	44.3458	<0.0001

Table 7: Chi Square Analysis—Three-Month Weight Change and Exercise Change (*N*=237)

Weight Change	Exercise Change		
	0	1	Total
0			
Frequency	171	13	184
Percent	72.15	5.49	77.64
Row Percent	92.93	7.07	
Col Percent	80.28	54.17	
1			
Frequency	42	11	53
Percent	17.72	4.64.	22.36
Row Percent	79.25	83	
Col Percent	19.72	20.75	
Total Frequency	213	24	237
Percent	89.87	10.13	100.00

Statistic	DF	Value	Probability
Chi-Square	1	8.4728	0.0036

Table 8: Logistic Regression Analysis—Predicting Three-Month Weight Change (self-reported regarding the previous three months)

Variable	DF	Parameter Estimate	Standard Error	*t* Value	*p* Value
ESES	1	0.00731	0.00449	1.63	0.1048
BMI	1	0.03359	0.01360	2.47	0.0142
Interaction (ESES*BMI)	1	-0.00031687	0.00014170	-2.24	0.0263