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Original Article

Self-quarantine and weight gain related risk factors during the COVID-19 pandemic

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ABSTRACT

Objective: The purpose of this study was to quantify the impact that self-quarantine has on behaviors associated with weight gain.
Methods: This was a quantitative descriptive/correlational research design. Research announcement was sent out via Facebook to 1200 possible participants. Six surveys were condensed into a single Survey Monkey questionnaire for participants to complete. Surveys asked questions relating to risk factors linked to weight gain.
Results: Ninety-one percent of our sample stated they spend more time at home now than before COVID-19. Twenty-two percent of the sample stated they gained 5–10 pounds. Within those who gained 5–10 pounds, there was a significantly higher percentage of the total sample who reported they increased eating in response to sight and smell ($p = .048$), eating in response to stress ($p = .041$), and snacking after dinner ($p = .016$) compared to those who stated they did not change those behaviors at all. There were significant relationships between predictor variables hours of sleep per night and physical activity time on reported weight gain ($r = -.195$, $p = .021$, $r = -.155$, $p = .034$, respectively).
Conclusion: Risk factors for weight gain during self-quarantine are inadequate sleep, snacking after dinner, lack of dietary restraint, eating in response to stress, and reduced physical activity.
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Introduction

The Centers for Disease Control and Prevention modeling suggested that, without mitigation, severe acute respiratory syndrome coronavirus2 (SARS-CoV-2), the virus that causes novel coronavirus disease 2019 (COVID-19), would have infected more than 60% of the US population [1]. President Donald Trump declared a national emergency along with 50 governors declaring state emergencies. Social distancing and self-quarantine were advocated to flatten the epidemic curve in the hope of moderating the effects the virus may have had on the healthcare system, morbidity, and mortality. This directive caused grade schools, universities, parks, and any non-essential business to close. Some cities such as San Francisco have gone so far to make it a misdemeanor offense to leave home for non-essential purposes. These measures were put into place to prompt self-quarantine. The influence of self-quarantine on factors that impact weight change and obesity-related behaviors in adults is unknown.

Children during the non-structure of summer will gain more weight than during the school year [2]. Thus, Rundle et al. hypothesized that increased unstructured time during the current COVID-19 pandemic will exacerbate obesity risk factors in children [3]. A longitudinal study recently published analyzed 41 children during self-quarantine and validated Rundle's hypothesis and found that eating, activity, and sleep behaviors altered in a manner that theoretically would promote weight gain [4]. Nonetheless, the impact of self-quarantine during the COVID-19 pandemic within *adults* on weight gain risk factors is unknown.

Increased unstructured time, the push to stay indoors, and heightened stress associated with the COVID-19 virus, have led to widespread concern that adults may gain weight during the current pandemic [5]. For example, a quick search of the term "quarantine 15" on Instagram and Facebook yields over 15,000 results. In addition to the lay population, researchers have suggested that

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What is already known?

- During the COVID-19 pandemic, children alter eating, sleep, and activity behaviors in a manner that promotes weight gain.
- The unprecedented self-quarantine mandate during the COVID-19 pandemic has led to widespread concern that adults *may* gain weight during the current pandemic.

What are the new findings?

- Roughly 22% of adults report having gained weight during the COVID-19 pandemic.
- Lack of sleep, decreased physical activity, snacking after dinner, eating in response to stress, and eating because of the appearance and smell of food are behaviors linked to weight gain during self-quarantine.

How might the results change the focus of clinical practice?

- The current study provides practical recommendations to reduce risk for weight gain during future circumstances that may require self-quarantine. These are: get the recommended amount of sleep, do not snack after dinner, practice dietary restraint, alter stress coping mechanisms, and maintain an exercise regimen.

self-quarantine may provoke depression, post-traumatic stress disorder, and lifestyle behaviors that could provoke obesity in adults [6,7].

Indeed, self-quarantine guidelines may provoke behaviors associated with weight gain and obesity. For example, although outdoor physical activity was still encouraged in some areas, it could be hypothesized that TV and screen time would increase during self-quarantine. Increased screen time in adults is a risk factor for obesity [8]. Additionally, mice placed in *private* housing gained more fat when compared to mice housed in groups [9]. In humans, social isolation has shown to be linked to increased leptin levels [10]. Thus, the number of people within a home may also impact weight gain during self-quarantine.

Lastly, eating is a response that takes place due to nutritive and non-nutritive cues. Increased time at home may provoke additional eating in response to non-nutritive cues. People who struggle with obesity often show an imbalance and oversensitivity to ëxternalör ñon-nutritiveëues to eat (social, emotional, or conditioned craving for certain foods), and a concomitant desensitization to ïnternalcües, mainly related to normal satiety processes [11].

Thus, the purpose of this descriptive/correlational study was to quantify the impacts of self-quarantine on behaviors associated with weight gain and obesity.

Subjects

Population

A priori G*Power estimates using bivariate correlational analysis was used as the research design to approximate sample size. An estimated effect size of .3, alpha error of .05, and a power of .95 projected that 111 subjects were needed to power this study accurately. Any adult over the age of 18 years could have completed the study. A research announcement was sent out via Facebook to 1200 possible participants. A 10% return rate was expected to yield roughly 120 participants for the study. Participants were placed in a raffle in which ten were drawn to receive a 25$ Visa gift card. The IRB at Grand Canyon University approved this study.

Material and methods

Study design

The research design used was a quantitative descriptive/correlational design. Once the subjects agreed to participate in the study, they received a link to a Survey Monkey questionnaire. The informed consent was at the beginning of the online survey. Subjects were asked to complete six surveys that were condensed into a single Survey Monkey questionnaire. Surveys asked questions relating to weight gain/obesity-related risk factors. Below outlines the survey details.

Surveys

1 Demographics questionnaire. Descriptive information was collected to characterize the subject population. Subjects were asked to reveal their age, gender, height, weight, employment status, duration of time spent indoors, weight change, and ethnicity. For ḋuration of time spent indoors,ṫhe participants were asked to choose one of the following: 8–12 h, 12–16 h, 16–20 h, or 20–24 h. For weight change participants were asked to choose one of the following options: lost >10 pounds, lost 5–10 pounds, maintained weight, gained 5–10 pounds, gained >10 pounds. Participants were then asked how accurate they felt their weight reporting was on a scale of 1–10.

2 Social network questions. These questions asked about the body size of those whom the participants socialize. Participants were asked if their romantic partner was overweight, and if their close friends/family were overweight. This line of questioning has been found reliable [12]. Participants were also asked how many people reside in their home.

3 Factors that contribute to eating questionnaire. The Weight and Lifestyle Inventory (WALI) was used to assess possible changes in factors that contribute to eating. All answers were reported on an ordinal scale with the following options: has not increased at all, increased a small amount, increased a moderate amount, increased a large amount, or increased the highest amount. The WALI is a reliable instrument often used in weight loss research [13].

4 Sedentary behavior questionnaire (SIT-Q) is an open access questionnaire that has been shown to be valid and reliable [14]. The SIT-Q was used to gage TV/screen time. Participants were asked to report the number of hours and minutes they spent watching TV or playing video games. A separate question asked the number of hours and minutes they spent working on the computer. The SIT-Q was also used to gage sleep time. Participants were asked to report in hours and minute the amount of sleep they receive each night.

5 The Recent Physical Activity Questionnaire was chosen to measure physical activity behaviors during self-quarantine. The Recent Physical Activity Questionnaire is an open access questionnaire that is valid and reliable [15]. Participants were asked to report how many times per week and duration in hours and minutes they engaged in different modes of physical activity. All reported physical activity times were summed, and total physical activity time per week was calculated.

6 The Perceived Stress Scale was used in this study to assess the impact of self-quarantine on stress. The PSS asks questions related to stress, and the participant is asked to report on an ordinal scale ranging from ñeverto v̈ery often.Ä total stress score is then calculated. The PSS has been found reliable and valid [16].

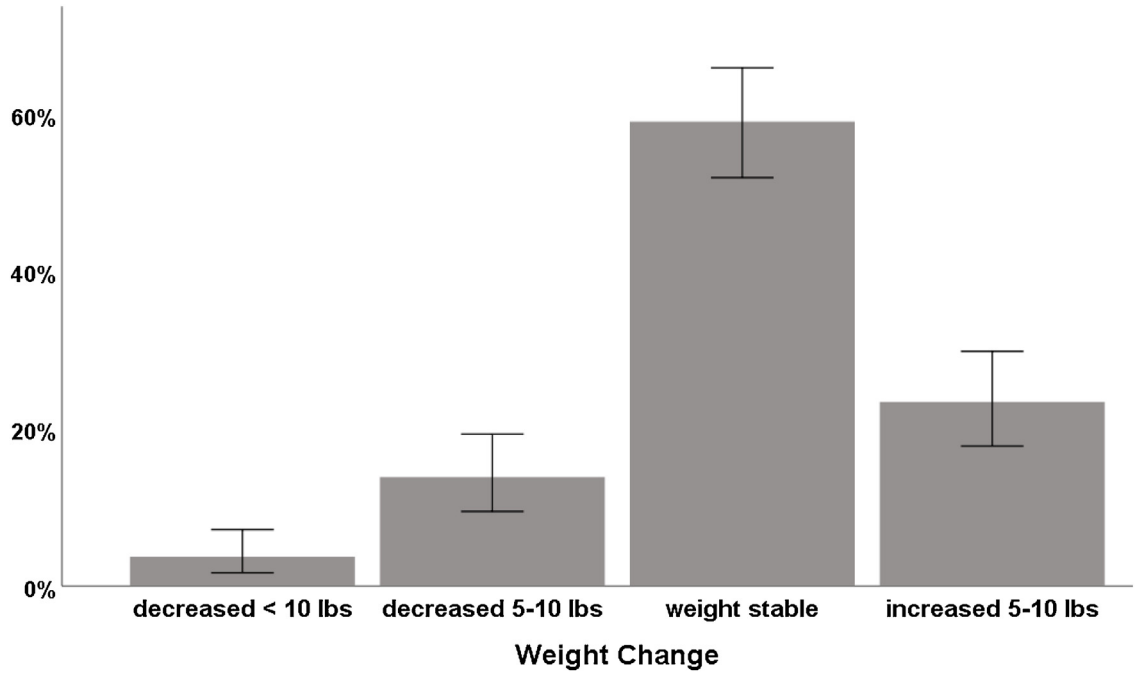

Fig. 1. Reported weight change during self-quarantine. Error bars represent 95% CI.

Statistical analysis

All statistical analyses were performed using SPSS software version 26 (SPSS 26.0 IBM Corporation, Armonk, New York, USA). Data are expressed as means ± standard deviation. Data were analyzed for normality, and values with skewed or kurtotic distributions were transformed to achieve normality. Descriptive statistics were used for the demographics of the participants and to describe the behaviors during self-quarantine. Pearson correlation was used to assess the relationships between the continuous predictor variables of sleep, TV time, and physical activity time and the criterion variable of weight change. Chi-square was used to determine frequency differences within the participants who gained weight and eating behaviors. Pairwise comparison in frequency differences were made using the z-test, and Bonferroni correction was applied in the statistical software to adjust for the p-value appropriately. All p-values were calculated assuming a two-tailed hypothesis, and $p < .05$ was considered statistically significant.

Results

Descriptive data

A priori sample calculation estimated a sample of 111 subjects was needed to power this study adequately. One hundred and seventy-three (96 females and 77 males) completed the surveys. Participants had an average age of 28.1 ± 12.5 years and an average BMI of 27.0 ± 7.6 kg/m [2]. Roughly 66% of the sample identified as White or Caucasian, 23% identified as Hispanic, 4% as African American, 4% as Asian, and 2% as Hawaiian. Roughly 32% of our sample reported being laid off due to the Coronavirus, 24% were considered essential and therefore were not laid off, 22% were not working prior and were not working at the time they took the survey, 20% was still working but with reduced hours, and 3% did not work before the crisis but now do work.

Participants were asked to report how many hours they spend inside their homes each day. Approximately 48% of the sample spent between 20–24 h per day inside their home. Roughly 91% of our sample stated that they spend either a ̈little moreör ̈much more ̈time at home now than before the Coronavirus.

Fig. 1 shows that nearly 59% of the sample reported they had remained relatively weight stable while 22% say they have gained 5–10 pounds thus far. Fifteen percent say they have lost 5–10 pounds, and 4% say they have lost more than 10 pounds.

Participants reported that they are sleeping, on average, 7.6 ± 1.3 h per night, spending roughly 4.8 ± 3.3 h per day watching TV or playing video games and 2.5 ± 2.4 h per day on the computer. Participants also reported that they accumulate roughly 2.7 ± 3.5 h per week of physical activity.

Eating behaviors

Table 1 details eating behaviors during self-quarantine. Roughly 59% stated that during self-quarantine they "eat more often with friends and family," 65% stated they increased "eating in response to sight and smell of food," 73% stated they increased "eating because they crave certain foods," 52% said they increased "eating in response to stress," 73% stated they increased "eating when bored," and 65% stated they increased "snacking after dinner."

Predictors of weight gain

Eating behaviors that were reported to increase during self-quarantine were analyzed in relation to weight change. The eating behaviors of: "eating with friends and family," "eating in response to sight and smell," "eating because you crave certain foods," "eating in response to stress," "eating when bored," and "snacking more after dinner" were analyzed in the Chi-square analysis. Within those who reported to gain 5–10 pounds there were no response frequency differences for eating behaviors of "eating with friends and family($\tilde{p}$ = .988), ëating when bored($\tilde{p}$ = .163), and ëating because I crave certain foods($\tilde{p} > .05$).

Fig. 2 shows that within those who gained 5–10 pounds there was a significantly higher percentage of the total sample who reported they had the ̈largest increase ̈for ëating in response to sight and smell ̈compared to those who stated they ̈did not change at all($\tilde{p}$ = .048). There were no frequency differences for ëating in

Table 1
Eating behaviors.

	Has not increased at all	Increased a small amount	Increased a moderate amount	Increased a large amount
Eating with friends and family	40.59%	17.65%	24.12%	17.65%
Eating in response to sight and smell of food	34.88%	39.53%	18.02%	7.56%
Overeating at dinner	61.27%	18.50%	11.56%	8.67%
Overeating at lunch	78.03%	11.56%	7.51%	2.89%
Overeating at breakfast	88.55%	11.56%	2.31%	0.58%
Eating because I crave certain foods	26.59%	38.15%	22.54%	12.71%
Eating when depressed or upset	50.29%	19.65%	15.61%	14.45%
Eating when stressed	47.98%	22.54%	12.14%	17.34%
Eating when angry	76.88%	7.51%	8.67%	6.92%
Eating when anxious	58.96%	17.92%	11.56%	11.56%
Eating when bored	27.17%	34.10%	17.34%	21.38%
Snacking after dinner	34.68%	32.95%	17.34%	15.03%

N = 173.

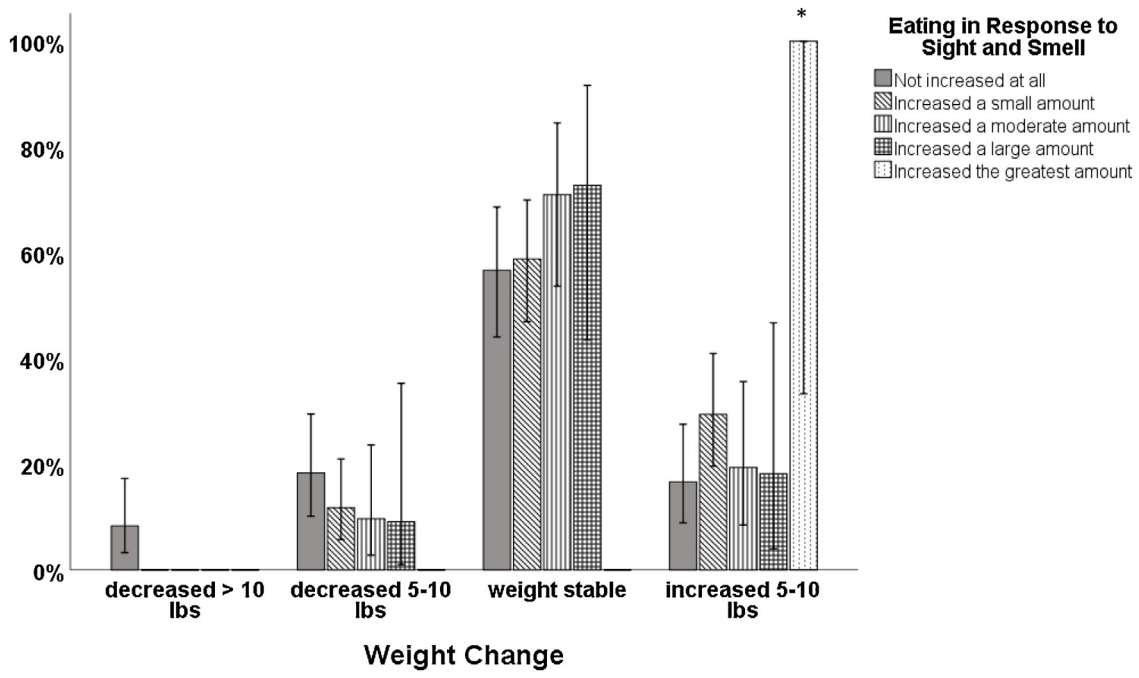

Fig. 2. Frequency differences with weight change groups on ëating in response to sight and smell. *Represents statistically different than the group who reported to ñot increase at all. Error bars represent 95% CI.

response to sight and smellẅithin any other group. Fig. 3 shows that within those who increased 5–10 pounds, there was a significantly higher percentage of the total sample who reported they had a ïarge increaseẗor ëating in response to stressc̈ompared to those who reported ño change at all(̈p = .041). There were no frequency differences for ëating in response to stresswithin any other group. Fig. 4 shows that within those who gained 5–10 pounds there was a significantly higher percentage of the total sample who reported they increased s̈nacking after dinnerb̈oth a m̈oderateänd ïargeämount compared to those who stated they d̈id not change at all(̈both p < .001). There were no frequency differences for s̈nacking after dinnerẅithin any other group.

Total screen time did not predict weight change in the current study (p = .401). There was a significant relationship between predictor variables hours of sleep per night and physical activity time on reported weight gain (r = −.195, p = .021, r = −.155, p = .034, respectively). The PSS (stress) data did not correlate with weight gain (p = .653). Additionally, having one's romantic partner being overweight did not appear to predict weight gain (p = .788). Lastly, the number of people quarantined with also did not significantly predict weight gain (p = .097).

Discussion

Within the current study, almost the entire sample stated they spend more time at home now compared to pre-pandemic, with roughly half reporting they spend nearly all waking hours at home. Thus, the premise for the study, increased time at home during self-quarantine, was validated. Twenty-two percent of the sample stated they gained between 5–10 pounds. Eating behaviors reported to increase during the quarantine were, "eating more often with friends and family," "eating in response to sight and smell of food," "eating because you crave certain foods," "eating in response to stress," "eating when bored," and "snacking more after dinner." Of those, eating behaviors linked with weight gain are "eating in response to sight and smell," "eating in response to stress," and "snacking after dinner."

Increased eating in response to sight and smell during quarantine could be considered a component of the psychological variables impulsivity and disinhibition. Impulsivity is a hasty reaction to an outside stimulus without concern for negative consequences and has been linked with binge eating [17]. Disinhibition, also called mindless eating, or the disruption of an inhibited state

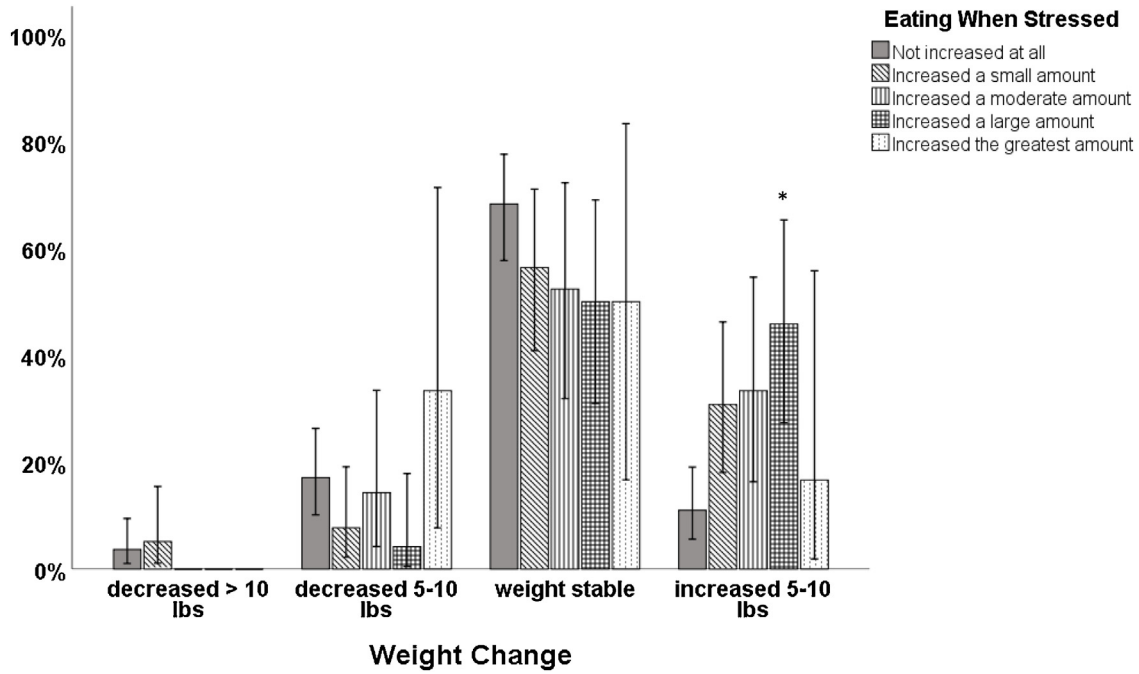

Fig. 3. Frequency differences for weight change groups on ëating in response to stress. *Represents statistically different than the group who reported to ñot increase at all. Error bars represent 95% CI.

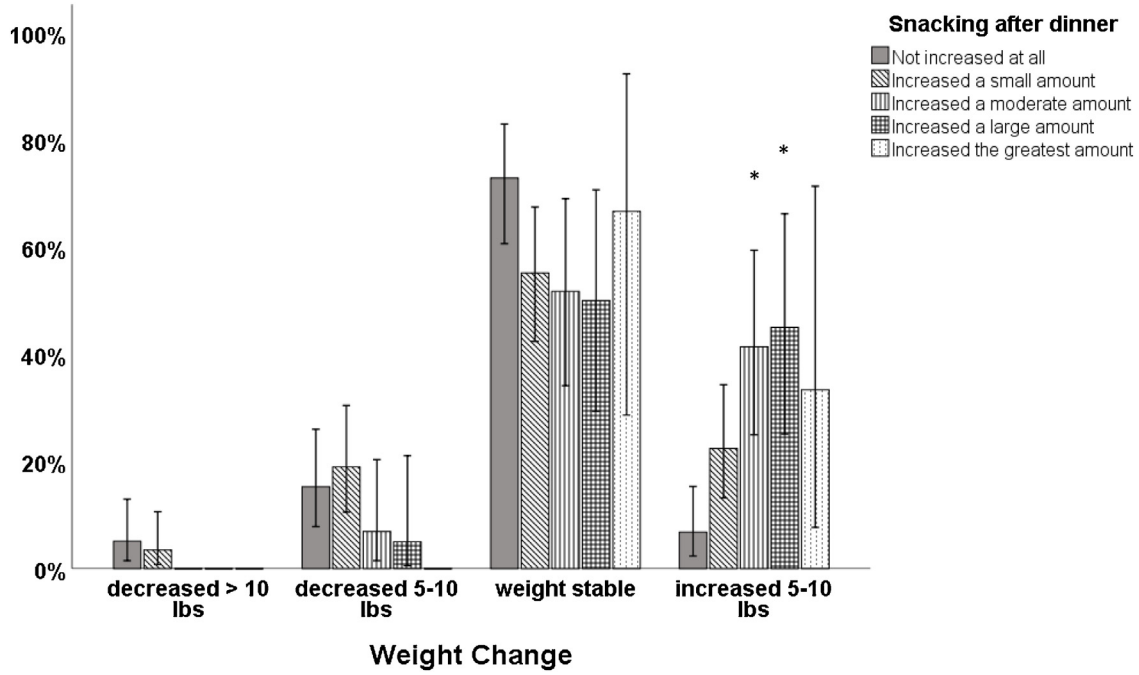

Fig. 4. Frequency differences for weight change groups on s̈nacking after dinner. *Represents statistically different than the group who reported to ñot increase at all. Error bars represent 95% CI.

where loss of control over eating may occur is also linked with weight gain [18]. It appears that during quarantine, those who gained weight simply ate because food was available, not necessarily because of internal hunger cues. Prior research shows that when subjects are provided with large portions of food for many days, they will consistently overeat even though they report decreased hunger and increased satiety [19].

On the other hand, although not directly measured, those who maintained or lost weight more than likely practiced dietary restraint. Dietary restraint is defined as the intention to restrict food intake to control body weight and shape and has been shown to predict long-term weight loss [20]. Practicing dietary restrain during self-quarantine should be encouraged.

Interestingly, even though the average PSS score for the entire sample indicated a moderate stress level (PSS: 13 ± 11), the PSS did not predict weight change. However, those who gained 5–10 pounds were more likely to eat in response to stress. It has been reported that roughly 40% of the population will decrease food intake in response to stress, 40% report increased food intake, and 20% report no change [21]. Thus, although stress levels were at

the level that indicated moderate stress, it is more than likely that within only those who use food as a coping mechanism did it deleteriously impact weight status. The current study did not assess differences in the stress response.

The link between snacking after dinner and weight gain is well supported in the literature. Emerging data has revealed that a high percentage of adipose tissue is diurnally regulated [22] and that calories consumed later in the day have a higher propensity to be stored within adipose tissue [23]. For example, researchers in 2013 [24] randomized 90 women into one of two weight loss groups. Both groups were assigned to a hypocaloric diet consisting of 1400 calories with similar macronutrient profiles. The only difference between the groups was that one consumed half of their daily caloric allotment for breakfast while the other consumed half for dinner. By the end of 12 weeks, the group that ate most of their calories for breakfast lost approximately 13 more pounds than the group that ate bigger dinners. Thus, reducing food intake after dinner could be a strategy that may aid in weight loss/maintenance during self-quarantine.

The current study also found that those who got fewer hours of sleep were more than likely to gain weight. It is plausible that the decreased sleep and increased snacking after dinner go hand in hand to provoke weight gain. Indeed, the majority of sleep research points to the fact that decreasing sleep duration promotes obesity because of increased opportunities to eat [25,26]. It is feasible that participants who reported less sleep ate more during the evening hours when they are awake. Lastly, hours spent in physical activity per week was another predictor of weight gain. Prior research supports this find as it is well established that exercise produces weight loss in a dose-response fashion [27].

It is of interest that the current study did not find a link between TV/screen time and weight gain. Although robust in children, conclusive evidence looking at sedentary behavior in adults promoting obesity is illusive. A 2017 review of ten reviews found limited evidence for an association between sedentary behavior, including screen time, and obesity risk in adults and stated that any association that may exist does not appear to be causal [28]. Our findings collaborate with this review that sedentary time may not be a predictor of weight gain in adults.

The current study is not without weaknesses. The biggest weakness of the current study is the fact that weight change was self-reported. However, the current study did not look at weight change as a continuous variable but on an ordinal scale. It could be argued that a participant could more accurately identify if they gained 5–10 pounds compared to identifying an exact number of pounds gained or lost. Additionally, subjects were asked on a scale of 1–10 to report how accurate they felt they could answer this question. The average response was a 9, implying very high accuracy. It must be noted that the current study had to be conducted via questionnaire due to social distancing guidelines. An additional weakness of the study comes in the form of subject recruitment. Because an e-mail was sent out on social media accounts and then dispersed from there, it could be argued that the sample is not an adequate representation of the population. Although this may be the case, the current study still provides unique information about an unprecedented event within the history of the world. Lastly, it is understood that the data collected could be spliced and analyzed in a myriad of ways. However, to maintain the integrity of the research, the author attempted to stay focused on answering the primary research question, that is, ẅhat are the impacts of self-quarantine on behaviors that impact weight gain?. Future studies can separate the population by race, gender, or BMI status to ask additional research questions.

The primary strength of the current study is an answer to a pressing question at an unprecedented time in human history. Additionally, the current study provides a lens for future research looking at self-quarantine and weight gain behavior using superior data collection techniques. Lastly, the current study provides practical recommendations for possible future circumstances that may require self-quarantine.

If these results were extrapolated to the population, they would have significant implications. Indeed, at the time of data collection and manuscript preparation, stringent self-quarantine practices are still being practiced. Thus, increased weight gain may impact a higher percentage of people when all is said and done. Future research should also look at post quarantine weight loss. Currently, it is unknown if gained weight during quarantine will be lost after self-quarantine measures are reduced. Whether one is looking at weight gain in children over summer or in adults over the holidays, data suggests that those who gain weight during those times periods more than likely will not lose the gained weight [2,29]. Thus, those who gained weight during self-quarantine may not return to pre-pandemic weight.

In conclusion, roughly 22% of the current sample reported gaining weight during self-quarantine. Predictors of weight gain during self-quarantine are: get adequate sleep, do not snack after dinner, practice dietary restraint, alter stress coping mechanisms, and maintain an exercise regimen. The predictors of weight gain should be disseminated as they are easily modifiable and could be used to stave off weight gain.

Conflicts of interest

There are no Conflicts of interest to declare.

Ethical statement

This research has been approved by the IRB at Grand Canyon University. All authors attest to this manuscript as presented.

Clinical trial registration

The current study is not a clinical trial.

Funding

There is no funding.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.orcp.2020.05.004.

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