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INTERMITTENT FASTING: THE SOLUTION TO OVEREATING AND FOOD CONSERVATION

By

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Introduction

As the world nears a population of close to 10 billion people due to overpopulation, it is time people start thinking more about the way they eat: not only how much but how often and when. Intermittent fasting can re-direct the skewed proportion of obese, overweight, and starving people by aiding in weight loss, reducing body fat, and various health benefits that enhance one's general well-being.

The proportion of people who are obese, overweight, and starving worldwide is staggering. Numbers from the past five years suggest that 13% of the world is obese, 39% of the world is overweight (Ritchie & Roser, 2017), while only 8-9% of the world is starving (World hunger: key facts and statistics 2021, 2021). In short, this means that more people in the world are obese than are starving. Many worldwide have too much, while others have too little. Obesity is having a body mass index (BMI) of over 30. Body mass index is a measurement that takes a person's weight (kg) divided by the square root of the person's height (m). BMI is a good indicator of a person's body fat (Body mass index (BMI), 2020).

Obesity is a problem that is shaped by environmental factors such as the availability of food and the affordability of more processed food, leading to an increase in obesity for countries worldwide. Though mainstream public health campaigns have been ineffective in the past, the disease of obesity and the behavior of overeating are curable. However, "Unlike other major causes of preventable disease death and disability, such as tobacco use, injuries, and

infectious diseases, there are no example populations in which the obesity epidemic has been reversed by public health measures” (Swinburn et al., 2011, p. 804). To fix the problem of worldwide obesity, we must propose a new solution. Intermittent fasting for the non-starving is the solution to feeding 10 billion people and solving worldwide obesity.

Intermittent fasting (IF) includes the cycling between periods of fasting and eating. “Intermittent fasting (IF) encompasses eating patterns in which individuals go extended periods (e.g., 16-48 h) with little or no energy intake, with intervening periods of normal food intake, on a recurring basis” (Mattson, Longo, & Harvie, 2017, p. 1). There are three common types of intermittent fasting: whole-day fasting, alternate-day fasting, and time-restricted feeding, which all regulate the times that a person eats. Whole-day fasting, commonly referred to as the 5:2 method, is when an individual abstains from eating for 1-2 days while eating as much or as desired, also referred to as *ad libitum*, for the remaining days of the week. Alternate day fasting involves 24-hour periods of not eating or eating 25% or less of what a person normally would, followed by 24 hours of eating *ad libitum*. Finally, time-restricted feeding involves blocking out periods of 14-20 hours each day to fast while eating *ad libitum* the remaining hours. A typical time-restricted feeding is 8 hours of eating with a 16 hour fast within 24 hours (Khedkar, 2020).

Presentation of Research

Historical Development

Intermittent fasting is by no means a "new" concept. Though it has gained a following as a "fad diet" in the last ten years, intermittent fasting is rooted in our evolutionary past. When

thinking back on our ancestors' lifestyle, it is important to recognize that the first thing they didn't do was eat a balanced breakfast when they woke up in the morning. Instead, our ancestors spent their days hunting and gathering to provide for their families. They learned how to survive hours without food because it wasn't always readily available to them. Their mealtimes varied considerably from day to day (Pruimboom & Muskiet, 2018). In essence, our ancestors followed an intermittent fasting diet due to food scarcity. Intermittent fasting is also rooted in various religions, such as Islam, where practicing individuals abstain from food and water from dawn until dusk throughout Ramadan.

Intermittent fasting became widely popularized in 2012 through Dr. Michael Mosley's documentary *Eat Fast, Live Longer* and subsequent book *The Fast Diet*. Journalist Kate Harrison also wrote a book titled *The 5:2 Code* that spoke of her personal experience of intermittent fasting (Tello, 2020). Through these media platforms, intermittent fasting became mainstream, though it had already been a topic of discussion among researchers for years prior. The popular media cannot overemphasize the importance of intermittent fasting. In the age of social media and fad dieting, intermittent fasting continues to generate buzz as a way to lose weight and live a healthier life.

Current Status of Research

Most of the current research done on intermittent fasting has taken place on rats and mice. Intermittent fasting is being studied as a weight loss and fat loss strategy as well as way to live an overall healthier life. The weight loss results in mice are undisputed: intermittent fasting significantly lowers body weight and body fat. Other research on the extended health benefits in mice has shown that fasting lowered resting heart and blood pressure, slowed the

progression of neurodegenerative disease and even tumor growth (Mattson, Longo, & Harvie, 2017). As the health benefits become clearer in mice and rats, studies are beginning to transition to human subjects to investigate whether the results will translate.

For example, a 2020 meta-analysis looked at the impact of alternate-day fasting on body mass index, waist circumference, body fat mass, lean body mass, and cardiometabolic risk factors in adults over 18 years old. The meta-analysis found that alternate-day fasting significantly reduced BMI and fat mass compared to other dietary methods while being particularly effective in overweight adults. It also found that subjects experienced significantly reduced waist circumference in obese adults over 40 who were practicing alternate-day fasting (Park et al., 2020).

Furthermore, time-restricted feeding has also been shown to lower BMI, even in healthy adults. A study from 2007 took healthy, non-obese adults with a BMI between 18 and 25 (well below the obesity marker) and assigned them to eat either three meals a day or one meal a day, with the same calorie count. The one meal a day group ate within a four-hour window coinciding with a 20-hour intermittent fast. The study observed that the individuals who were only eating one meal a day had a decrease in body fat mass and some weight loss. Interestingly enough, the time-restricted feeding group also had a significant decrease in cortisol concentrations (Stote et al., 2007). This study shows that intermittent fasting effectively lowers excess fat in people who do not qualify as obese while providing health benefits.

Moreover, when the body is used to a diet of intermittent fasting, hunger levels begin to decrease over time. A key regulator of hunger within the body is the hormone ghrelin. At times

between meals or at times of food deprivation, the circulating ghrelin levels would increase. However, interestingly enough, in individuals who are intermittent fasting, ghrelin levels decrease. For instance, an observational study followed obese and overweight subjects practicing diurnal fasting throughout Ramadan. Over time, there was a significant decrease in ghrelin circulating levels at the end of Ramadan (Al-Rawi et al., 2020). This finding was consistent with previous studies on the hormone levels of those who practice intermittent fasting. Though it may seem counterintuitive, during intermittent fasting and going without food, the desire for food decreases. A person feels more satiated because of the decreased levels of ghrelin. These decreased hunger levels bode well for the likelihood of obese and overweight people who already struggle with portion control and maintenance of hunger levels will effectively practice intermittent fasting. Decreased hunger levels lead to a decrease in overeating and, theoretically, more food available to redistribute to those worldwide who need it more.

With obesity comes a plethora of accessory health problems, such as cardiovascular disease. The most prevalent form of cardiovascular disease comes in the form of coronary artery disease, one of the leading causes of death in the U.S. Intermittent fasting lowers the risk of coronary artery disease in mice and human studies alike. For example, a study from 2012 took 60 obese women and randomly assigned them to intermittent fasted, calorie-restricted diets for eight weeks in the form of liquid or solid foods. In the end, both groups ended up losing over 2.5% of their body weight while lowering their risk of coronary artery disease (Klempel, Kroeger, Bhutani, Trepanowski, & Varady, 2012). Overall, this suggests that

intermittent fasting can be effective long-term due to significant weight loss and decreased risk of developing deadly diseases like coronary artery disease.

Another hallmark condition of obesity and excessive caloric intake is chronic inflammation. When looking at 151 healthy subjects throughout the Islamic fasting month of Ramadan, a 2012 study found a significant decrease in proinflammatory cytokines such as TNF- α , IL-1, and IL-6 that led to chronic inflammation. Additionally, the study found that the individuals who had been practicing intermittent fasting had a significant decrease in body weight, body fat, and hip and waist circumference (Faris et al., 2012). Though this study looked at healthy individuals, the results suggest that long-term practice of intermittent fasting can be effective at lowering chronic inflammation in those who are obese. This result is important because if people start intermittent fasting, chronic inflammation could be lowered and help with overall weight loss.

A common research question is whether any other practice can combine with intermittent fasting to increase the positive body composition effects. One possibility involved the combination of exercise in high-intensity interval training (HIIT) and intermittent fasting. One experiment conducted in 2018 took obesity-induced mice and attempted to investigate a possible combinational effect between intermittent fasting and high-intensity interval training to prevent significant weight gain in obese populations. The study compared mice in intermittent fasting groups, groups that practice HIIT without fasting, and an experimental group of mice that intermittent fasted and exercised. The experimental group of mice did high-intensity interval training as their form of exercise. Results found that intermittent fasting or intermittent fasting combined with high-intensity exercise helped prevent significant weight

gain in obese mice more than strictly exercise alone (Wilson et al., 2018). This study helps demonstrate that intermittent fasting with or without exercise still has a more positive effect for preventing weight gain than exercise alone.

Other Health Benefits

In addition to enhancing weight loss and lowering BMI, current research suggests intermittent fasting has other benefits to one's health. Researchers have found that intermittent fasting in mice helps slow tumor growth. In a 2021 review, researchers observed that intermittently fasted mice with cancer had slower tumor growth. This delayed tumor development was due to alterations in the metabolism of tumor cells caused by intermittent fasting. These alterations lead to tumor growth inhibition while it also increased tumor sensitivity to a few cancer treatments. The treatments included commonly used chemotherapy and radiotherapy (Zhao et al., 2021). More research on humans is needed to make more evident conclusions on the link between intermittent fasting and cancer. Intermittent fasting has a promising future in acting as a component for cancer treatment.

Intermittent fasting has also been found to have benefits on the cellular level. Various studies found that cellular mechanisms occur due to intermittent fasting and time-restricted feeding. These mechanisms activate pathways that would help promote cellular repair and activation in the cells of the body. Along with molecular changes, a rhythm of fasting stimulates the fluctuation of our gut microbiota (Hu et al., 2021). This combination helps restore a healthier circadian rhythm; an inherent clock formed throughout millions of years of human evolution.

Another noteworthy health benefit is intermittent fasting as a strategy to help treat and counteract cognitive decline. A 2021 study looked at 833 elderly adults in Southern Italy who practiced time-restricted feeding, fasting for 14 hours a day. Many of the 833 adults showed signs of cognitive decline before the institution of intermittent fasting. After an extended period, researchers found that those who fasted were less likely than the ad libitum control group to have cognitive impairment (Currenti et al., 2021). This result demonstrates a positive association between intermittent fasting and reducing cognitive decline in elderly adults of Southern Italy. This association potentially opens up other possibilities of intermittent fasting benefits to the brain. Cognitive and fasting research should continue to explore other possible benefits from intermittent fasting on the brain or even potentially some adverse effects from fasting.

Potential Concerns

Overeating is a possible side effect of intermittent fasting (IF). A study in 2014 looked at changes to the quantities of hypothalamic neurotransmitter mRNAs found in IF animals. The study found that IF mice were overeating. Results presented an elevated neuropeptide Y (NPY) expression and agouti-related peptide (AGRP) and increased orexin expression during fasting. These results help potentially explain why overeating occurs while practicing intermittent fasting. Overeating happens because both NPY and AGRP play a role in the hypothalamus controlling hunger levels. As either of these neurotransmitters increases from fasting, so does hunger in the mice. The mice then eat a larger volume of food (Chausse et al., 2014).

The effect of overeating is still researched amongst humans, but some studies have discussed the potential increased risk of binge eating behavior in the long term. One study investigating these risks in 2008, which found an increased risk for recurrent binge eating and bulimic pathology for individuals who desire to practice intermittent fasting over the five-year study. The results found that 8% of the participants showed other signs of binge eating. Another 5% of participants showed characteristics of bulimia (Stice et al., 2008). On the other hand, a 2019 study took 23 obese individuals who were obese and at risk of developing eating disorder symptoms and put them on a 16:8-time-restricted feeding diet for 12 weeks. At the end of the 12 weeks, it was self-reported among the obese participants that eating disorder symptoms such as depression, binge eating, forceful vomiting, and concerns about body size and shape did not change from baseline to the end of 12 weeks of time-restricted feeding. Simultaneously, bodyweight significantly decreased for all participants (Gabel, Hoddy, & Varady, 2019). These results are an important area that needs further research. More evidence is required to determine whether fasting directly results in bulimia or binge eating or if a person who is already at high risk for both is deciding to have a desire to practice intermittent fasting.

Individuals with type 2 diabetes should keep various factors in mind before deciding to practice intermittent fasting. A study in 2018 discussed that intermittent fasting is safe if any potential factors cause hypoglycemia. Researchers recommend that someone who has diabetes understands the risks of any medication that they are taking. That is why the researchers strongly recommend any type 2 diabetic patient discuss first with their doctor before starting any fasting period (Carter et al., 2018). A type 2 diabetic can participate in intermittent fasting, but the diet must be closely controlled with medical advising.

Pregnancy and fasting have been a topic that is expanding in research. One study in 2018 looked at Ramadan fasting on pregnancy and babies' birth weight. The study found no link between fasting during pregnancy and low birth weight. More research needs to be done to investigate any potential other adverse effects from intermittent fasting or fasting in general during pregnancy (Glazier et al., 2018). There could be other unknown effects outside of birth weight that could be affected.

Children ranging from ages 0-18 are a group that has minimal research surrounding the effects of fasting. One 2014 study looked at the impact of fasting from Ramadan on obese adolescents. The study measured multiple variables before Ramadan, during the last week Ramadan, and six weeks after Ramadan ended. The results found the harmful effects of increased markers for heart rate, total cholesterol, LDL cholesterol, HDL cholesterol, and hs-CRP during Ramadan's last week compared to before Ramadan. However, six weeks after Ramadan, results showed a normalized level of the once previously high increased markers (Radhakishun et al., 2014). This study demonstrates that children are potentially at risk when they take part in intermittent fasting. Parents must understand risks because children need to eat a proper diet high in nutrients and caloric intake to assist in their growth and development. More research is necessary for intermittent fasting and the potential effects on children. It is currently recommended that a child is overweight or obese and needs to lose weight that they discuss with a medical professional for assistance. If a child is to do intermittent fasting, they must be highly supervised by a professional in medicine.

The effects of fasting on athletes have been a topic of research with a wide range of potential health information. One study in 2007 looked at the effects of fasting on a

professional team of Muslim soccer players during Ramadan. Before and after Ramadan, speed, agility, dribbling speed, and endurance for the soccer players were measured. After the conclusion of Ramadan, results found a significant decrease in quality of performance for all of the tests. The researchers also asked the players how they felt. 70% of the players felt their training was affected by the fasting of Ramadan (Zeguiri et al., 2007). A 2009 review by Chaouachi looked at studies across various sports that involve the effects of fasting on athletes. A majority of them found that fasting could hinder a performance. Poor eating and fasting patterns tend to be the reasons for poor performance for athletes that fast. Proper practices could counter these harmful effects. The review by Chaouachi found that if athletes maintain an appropriate total intake of calories, micronutrients, and sleep, they are less likely to see any adverse effects on their sports performance (Chaouachi et al., 2009). This review demonstrates that athletes can appropriately do fasting with proper timing and quality of eating and fasting patterns while not inhibiting athletes' performance or health.

Area of Disagreement

An area of disagreement within intermittent fasting as a weight-loss strategy is whether it is more effective than continuous energy restriction, eating around 75-80% of the average caloric intake each day. On the one hand, a former study randomly assigned 107 obese women to either an intermittent fasted diet or a continuous energy restriction diet for a length of 6 months. The fasted group ate ad libitum five days a week and fasted to 25% or lower of their regular caloric intake two non-consecutive days a week. The continuous energy restriction diet

group ate 75% of the calories that they would typically eat. At the end of the six months, 64% of the women on the intermittent fasting diet lost 5% or more of their body weight, while only 55% of the women on the continuous energy restriction diet lost 5% or more of their body weight (Harvie et al., 2011). This study suggests that intermittent fasting may be more effective at lowering body weight than simply “going on a diet.”

On the other hand, a more longitudinal study followed obese individuals for the entirety of a year. The participants split up into either a 5:2 intermittent fast or a continuous energy restriction diet. Both groups ate the same number of calories each day, just at different intervals. At the end of one year, the results showed that intermittent fasting effectively helped obese individuals lose clinically significant weight but that it was not significantly better than continuous energy restriction at doing so (Sundfor, Svendsen, & Tonstad, 2018). Though both studies mentioned earlier, results indicated intermittent fasting works to effectively lower body weight. More research is needed to determine if intermittent fasting is better than continuous energy restriction.

Future Research and Suggestions

For future research, more human studies must be conducted to confirm that all of the health benefits that apply to rats and mice also apply to human subjects. Researchers should also try to determine which type of intermittent fasting has better outcomes. Alternate-day fasting, 5:2 whole day fasting, and time-restricted feeding are all beneficial, but there is no clear consensus as to which is best. Furthermore, there is little research available that investigates

any adverse effects of intermittent fasting in the long term, if any. More longitudinal studies are needed to determine if intermittent fasting has any adverse health outcomes in the long term.

Future research surrounding the potential adverse effects of fasting should focus heavily on possible at-risk groups such as people with diabetes, athletes, and pregnant women. There may be other effects that could negatively impact these groups from fasting. It is essential to compare the various types of intermittent fasting in these groups. This comparison can provide insight into what type of fasting is potentially beneficial or harmful to these multiple groups. Potentially there isn't a one size fits all fasting method. That is why research is vital to test the various fits between certain groups and specific fasting methods. This research between groups and methods could potentially lead to good or bad matches between the two.

In terms of feeding 10 billion people, intermittent fasting in the form of alternate-day fasting, whole-day fasting, or time-restricted feeding should be implemented as the standard diet for the overweight and obese to distribute the global food supply better. In addition to helping the obese and overweight eat less and lose weight, intermittent fasting has numerous health benefits for all body types. However, it isn't suggested for those who are grossly underweight, those who have high caloric needs, or those at risk of developing an eating disorder (The dangers of intermittent fasting, 2019). If the voracious across the world were to practice intermittent fasting as their standard diet, there would be excess food available to redistribute to people who need it more. Feeding 10 billion people doesn't require changing anything about the environment; climate change makes that hard enough. Instead, changing the conventional diet of obese, overweight, and healthy weight people to intermittent fasting

rather than eating ad libitum can reverse the skewed global distribution of obese, overweight, and starving, improving the general wellness of millions of people.

Conclusions and Recommendations

Simply put, intermittent fasting works and works well. Implementation of intermittent fasting as the status quo diet for those with an elevated BMI and body leads to weight loss, fat loss, and decreased BMI in humans. Also, there are various benefits to overall health and wellbeing that come with intermittent fasting. Intermittent fasting is the solution to the tragically skewed distribution of obese and overweight worldwide versus starving.

To effectively feed 10 billion people, the non-starving population must normalize the intermittent fasting diet as a new regular lifestyle. The current status quo for eating in various parts of the world includes three meals a day. This diet involves people eating in the morning for the meal known as breakfast and then eating a midday meal called lunch and an evening meal called dinner. Intermittent fasting tends to gear towards the direction of only having one or two meals a day. Intermittent fasting is a flexible diet when people can eat, just if they have a built-in period of fasting between certain meals. The normalization of intermittent fasting can decrease overconsumption of food which will help reduce strain for finding food sources for those who need it.

Intermittent fasting can potentially have risks for certain groups of individuals. These at-risk groups include pregnant women, athletes, children, and people with diabetes. Intermittent fasting's effects should continue to be researched on these groups and possibly other groups. This expansion of research could help provide more insight into the safety of fasting. Until that

research is done, at-risk groups should approach fasting with caution and have a proper medical consultation before partaking in intermittent fasting.

The normalization of this diet would bring forth many other benefits alongside it. There are plenty of studies that show intermittent fasting resulting in weight loss, fat loss, and lowering of BMI. But more studies should be done centered around the other potential effects of positive changes. These effects include positive changes in blood composition, slowing of tumor growth, enhancement of cell repair, alignment of circadian rhythm, and slowed the progression of neurodegenerative diseases and cognitive decline in humans. More research can help affirm and establish research for these other benefits.

A crucial aspect of intermittent fasting outside of the benefits that come with it includes the possibility that it could eliminate food consumption and food demand. This simple change in diet normalcy could play a prominent role in reducing food supplies' stress across the world. This stress reduction can potentially create a future where the environment and its resources aren't as strained or abused to deliver food to our tables, even with a world population of 10 billion people.

Literature Cited

Al-Rawi, N., Madkour, M., Jahrami, H., Salahat, D., Alhasan, F., BaHamam, A., & Faris, M. A. I. (2020). Effect of diurnal intermittent fasting during Ramadan on ghrelin, leptin, melatonin, and cortisol levels among overweight and obese subjects: A prospective observational study. *Plos One*, 15(8). doi: 10.1371/journal.pone.0237922

Anis, C., Leiper, J. B., Nizar, S., Coutts, A. J., & Karim, C. (2009). Effects of ramadan intermittent fasting on sports performance and training: A review. *International Journal of Sports Physiology and Performance*, 4(4), 419-434. doi:10.1123/ijsp.4.4.419

Body mass Index (BMI). (2020, September 17). Retrieved April 05, 2021, from <https://www.cdc.gov/healthyweight/assessing/bmi/index.html>

Carter, S., Clifton, P. M., & Keogh, J. B. (2018). Effect of Intermittent Compared With Continuous Energy Restricted Diet on Glycemic Control in Patients With Type 2 Diabetes: A Randomized Noninferiority Trial. *JAMA Netw Open*, 1(3), e180756. doi:10.1001/jamanetworkopen.2018.0756

Chaouachi, A., Leiper, J. B., Souissi, N., Coutts, A. J., & Chamari, K. (2009). Effects of Ramadan intermittent fasting on sports performance and training: a review. *Int J Sports Physiol Perform*, 4(4), 419-434. doi:10.1123/ijsp.4.4.419

Chausse, B., Solon, C., Caldeira da Silva, C. C., Masselli Dos Reis, I. G., Machado-Gobatto, F. B., Gobatto, C. A., . . . Kowaltowski, A. J. (2014). Intermittent fasting induces hypothalamic modifications resulting in low feeding efficiency, low body mass and overeating. *Endocrinology*, 155(7), 2456-2466. doi:10.1210/en.2013-2057

Currenti, W., Godos, J., Castellano, S., Caruso, G., Ferri, R., Caraci, F., . . . Galvano, F. (2021). Association between Time Restricted Feeding and Cognitive Status in Older Italian Adults. *Nutrients*, 13(1). doi:10.3390/nu13010191

Faris, E., Kacimi, S., Al-Kurd, R. A., Fararjeh, M. A., Bustanji, Y. K., Mohammad, M. K., & Salem, M. L. (2012). Intermittent fasting during Ramadan attenuates proinflammatory cytokines and immune cells in healthy subjects. *Nutrition Research*, 32(12), 947-955. doi:10.1016/j.nutres.2012.06.021

Gabel, K., Hoddy, K. K., & Varady, K. A. (2019). Safety of 8-h time restricted feeding in adults with obesity. *Applied Physiology Nutrition and Metabolism*, 44(1), 107-109. doi:10.1139/apnm-2018-0389

- Glazier, J. D., Hayes, D. J. L., Hussain, S., D'Souza, S. W., Whitcombe, J., Heazell, A. E. P., & Ashton, N. (2018). The effect of Ramadan fasting during pregnancy on perinatal outcomes: a systematic review and meta-analysis. *BMC Pregnancy Childbirth*, *18*(1), 421. doi:10.1186/s12884-018-2048-y
- Harvie, M. N., Pegington, M., Mattson, M. P., Frystyk, J., Dillon, B., Evans, G., . . . Howell, A. (2011). The effects of intermittent or continuous energy restriction on weight loss and metabolic disease risk markers: a randomized trial in young overweight women. *International Journal of Obesity*, *35*(5), 714-727. doi:10.1038/ijo.2010.171
- Hu, D., Xie, Z., Ye, Y., Bahijri, S., & Chen, M. (2020). The beneficial effects of intermittent fasting: an update on mechanism, and the role of circadian rhythm and gut microbiota. *Hepatobiliary Surg Nutr*, *9*(5), 597-602. doi:10.21037/hbsn-20-317
- Khedkar, P. H. (2020). Intermittent fasting-The new lifestyle? *Acta Physiologica*, *229*(4). doi:10.1111/apha.13518
- Klempel, M. C., Kroeger, C. M., Bhutani, S., Trepanowski, J. F., & Varady, K. A. (2012). Intermittent fasting combined with calorie restriction is effective for weight loss and cardio-protection in obese women. *Nutrition Journal*, *11*. doi:10.1186/1475-2891-11-98
- Mattson, M. P., Longo, V. D., & Harvie, M. (2017). Impact of intermittent fasting on health and disease processes. *Ageing Research Reviews*, *39*(Sp. Iss. SI), 46-58. doi:10.1016/j.arr.2016.10.005
- Park, J., Seo, Y. G., Paek, Y. J., Song, H. J., Park, K. H., & Noh, H. M. (2020). Effect of alternate-day fasting on obesity and cardiometabolic risk: A systematic review and meta-analysis. *Metabolism-Clinical and Experimental*, *111*. doi: 10.1016/j.metabol.2020.154336
- Pruimboom, L., & Muskiet, F. A. J. (2018). Intermittent living; the use of ancient challenges as a vaccine against the deleterious effects of modern life - a hypothesis. *Medical Hypotheses*, *120*, 28-42. <https://doi.org/10.1016/j.mehy.2018.08.002>
- Radhakishun, N., Blokhuis, C., van Vliet, M., von Rosenstiel, I., Weijer, O., Heymans, M., ... Diamant, M. (2014). Intermittent fasting during ramadan causes a transient increase in

total, ldl, and hdl cholesterol and hs-crp in ethnic obese adolescents. *European Journal of Pediatrics*, 173(8), 1103–1106. <https://doi.org/10.1007/s00431-014-2276-8>

Ritchie, H., & Roser, M. (2017, August 11). Obesity. Retrieved April 05, 2021, from <https://ourworldindata.org/obesity#what-share-of-adults-are-obese>

Stice, E., Davis, K., Miller, N. P., & Marti, C. N. (2008). Fasting increases risk for onset of binge eating and bulimic pathology: a 5-year prospective study. *J Abnorm Psychol*, 117(4), 941-946. doi:10.1037/a0013644

Stote, K. S., Baer, D. J., Spears, K., Paul, D. R., Harris, G. K., Rumpler, W. V., . . . Mattson, M. P. (2007). A controlled trial of reduced meal frequency without caloric restriction in healthy, normal-weight, middle-aged adults. *American Journal of Clinical Nutrition*, 85(4), 981-988.

Sundfor, T. M., Svendsen, M., & Tonstad, S. (2018). Effect of intermittent versus continuous energy restriction on weight loss, maintenance and cardiometabolic risk: A randomized 1-year trial. *Nutrition Metabolism and Cardiovascular Diseases*, 28(7), 698-706. doi: 10.1016/j.numecd.2018.03.009

Tello, M. (2020, February 10). [Web log post]. Retrieved March 31, 2021, from <https://www.health.harvard.edu/blog/intermittent-fasting-surprising-update-2018062914156>

The dangers of intermittent fasting. (2019, October 22). Retrieved April 06, 2021, from <https://centerfordiscovery.com/blog/the-dangers-of-intermittent-fasting/#:~:text=Individuals%20who%20are%20underweight%2C%20struggling,daily%20basis%20for%20proper%20development.>

Wilson, R. A., Deasy, W., Stathis, C. G., Hayes, A., & Cooke, M. B. (2018). Intermittent fasting with or without exercise prevents weight gain and improves lipids in diet-induced obese mice. *Nutrients*, 10(3). doi:10.3390/nu10030346

World hunger: Key facts and statistics 2021. (2021, January 12). Retrieved April 05, 2021, from <https://www.actionagainsthunger.org/world-hunger-facts-statistics>

Zerguini, Y., Kirkendall, D., Junge, A., & Dvorak, J. (2007). Impact of Ramadan on physical performance in professional soccer players. *British journal of sports medicine*, 41(6), 398–400. <https://doi.org/10.1136/bjism.2006.032037>

Zhao, X., Yang, J., Huang, R., Guo, M., Zhou, Y., & Xu, L. (2021). The role and its mechanism of intermittent fasting in tumors: friend or foe? *Cancer Biol Med*, 18(1), 63-73. doi: 10.20892/j.issn.2095-3941.2020.0250