Obesity, Chronic Stress, and Stress Reduction

Donald Goens, MD[a], Nicole E. Virzi, MS[b], Sarah E. Jung, MA[c], Thomas R. Rutledge, PhD[c], Amir Zarrinpar, MD, PhD[a,c,*]

KEYWORDS

- Insulin resistance • Cardiovascular disease • Metabolic syndrome
- Nonalcoholic fatty liver disease • Caloric restriction
- Mindfulness-based interventions • Circadian rhythms • Sleep

KEY POINTS

- The current obesity epidemic is the result of the misalignment between human biology and the modern food environment, which has led to unhealthy eating patterns and behaviors and an increase in metabolic diseases.
- This has been caused by the shift from a "leptogenic" to an "obesogenic" food environment, characterized by the availability of unhealthy food and the ability to eat at any time of day due to advances in technology.
- Stress eating is a common response to chronic stress that can contribute to weight gain and obesity and can be addressed through stress reduction strategies such as mindfulness-based interventions.
- The increase in light at night, shift work, and the availability of high-caloric foods at abnormal times can lead to chronic stress and circadian dyssynchrony, which has negative impacts on metabolism and can increase the risk of obesity and other diseases.
- One dietary approach to address circadian dysregulation is time-restricted eating (TRE), which involves restricting food intake to specific periods of the day to synchronize the body's internal clock with the external environment.

INTRODUCTION

Few health problems capture the dynamic interaction between human biology and the environment better than the current obesity epidemic. Although circadian and appetite biological systems were aligned well with the demands of the premodern world to

[a] Division of Gastroenterology, UC San Diego, 9500 Gilman Drive, La Jolla, CA 92093, USA; [b] Department of Clinical Psychology, San Diego State University/University of California, San Diego Joint Doctoral Program, 6363 Alvarado Court, San Diego, CA 92120, USA; [c] VA San Diego Health Sciences, 3350 La Jolla Village Drive, San Diego, CA 92161, USA
* Corresponding author. Division of Gastroenterology, UC San Diego, 9500 Gilman Drive, La Jolla, CA 92093.
E-mail address: azarrinp@ucsd.edu

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promote survival in unstable food environments, these same systems are now misaligned with the modern food environment to instead promote obesity, metabolic diseases, and eating disorders.[1] This article will provide an overview of ways in which this biology-environment interaction has shifted in the last half-century to predispose individuals to develop metabolic diseases related to overnutrition and unhealthy eating patterns and behaviors, and to highlight validated treatments to reverse these trends.

Consider some of the most important food environment changes occurring in recent decades. In the "leptogenic" food environment characterizing the Western world prior to the mid-20th century, food was unprocessed, high in fiber, nutrient dense, and available only at limited times.[2] The premodern food environment was characterized by high energy demands for obtaining and preparing food and lighting constraints that limited eating to daytime and early evening hours. Culture played a complimentary role by encouraging social and family-oriented eating patterns that partly constrained both food choices and food quantities.

In just a few decades, however, centuries of biologically, socially, and culturally regulated aspects of eating and appetite were replaced by an "obesogenic" environment.[2] Food became hyperpalatable, calorie dense, and fiber and nutrient poor. Advances in food technology further made these premade foods available ubiquitously. Combined with similar advances in commercial electricity and multimedia entertainment, these changes enabled eating across day and nighttime hours to become not only possible but desirable and even normative.[3] With rapid changes in society, food and eating themselves assumed new meanings. Traditionally tied to family meals and cultural events, food evolved to become a form of self-expression, a source of entertainment, the focal point of holidays, and a means of coping with stress.[4] The latter form of coping, described further in the subsections later in this discussion, became widespread as the type of stress we experienced in society gradually transformed from mostly acute stress to primarily chronic stress. These physical changes in the food environment, coupled with behavioral and psychological changes in eating patterns and preferences, may help explain both the rapid rise of obesity in recent decades and the difficulties sustaining weight loss with conventional behavioral treatments (**Fig. 1**).[5] As a result of these interactive changes, our circadian and appetite regulatory systems are disrupted by the modern food environment, with the sobering result being that an estimated 88% of Americans were metabolically unhealthy in 2018.[6]

CLINICS CARE POINTS

- The modern food environment is contributing to the obesity epidemic and related metabolic diseases.
- Food has become more processed, calorie-dense, and lacking in nutrients compared to the premodern environment.
- Changes in food technology, commercial electricity, and multimedia entertainment have enabled eating at all hours of the day and night.
- Food has also taken on new meanings, such as a form of self-expression and a means of coping with stress.
- These changes in the food environment and eating patterns have disrupted circadian and appetite regulatory systems, leading to an estimated 88% of Americans being metabolically unhealthy in 2018.

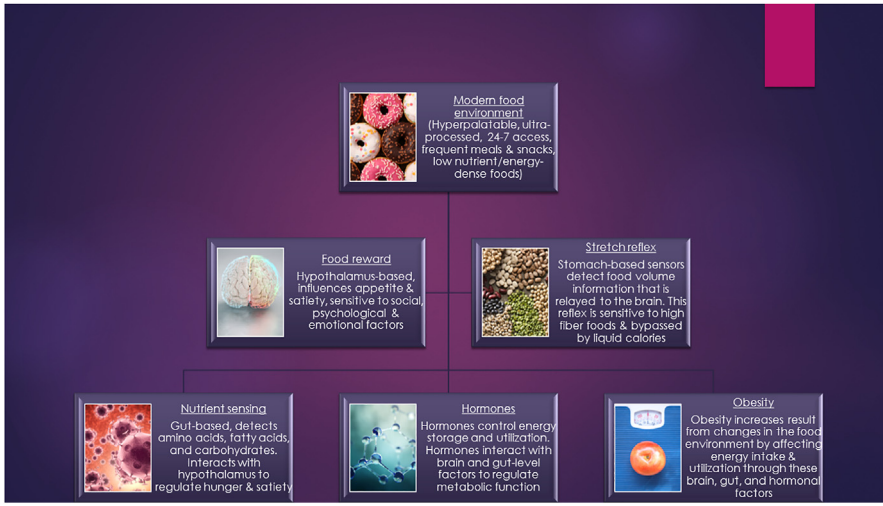

Fig. 1. Psychophysiological mechanisms contributing to the obesity epidemic.

STRESS EATING AND EMOTIONAL EATING

Stress eating or emotional eating is a maladaptive behavioral response to stress. While some people may undereat and/or lose weight under stressful conditions, approximately 70% of individuals tend to overeat and/or gain weight in response to stress.[7] Stress eating also typically involves ingesting calorically dense and highly palatable foods, also known as "comfort foods." In conjunction with the overabundance of food and a modern, sedentary lifestyle, stress eating behavior plays an important role in unintended weight gain, metabolic health, and the continuing obesity epidemic.

The traditional, physiological model of stress includes the "fight or flight" mode in response to acute (ie, life threatening) stress. In this model, acute stress triggers a cascade of sympathetic hormones that redirects bodily and organ functioning away from metabolic and appetitive mechanisms, such as food intake and digestion.[8] Instead of the acute stress most often faced by our premodern ancestors, in the modern world individuals are more likely to face stressors that are long-term, cumulative, and psychosocial in nature – that is, chronic stress. Chronic stress instigates an HPA-axis-regulated endocrine response, in particular the release of cortisol, which induces overeating of energy-dense foods.[9] Eating these "comfort foods"—those that are high in fat and carbohydrate content—may reduce the chronic-stress activation of the HPA-axis.[10] Thus, stress eating or emotional eating can be fundamentally understood as a coping mechanism to chronic stress.

Men and women respond differently to stress. Women are more likely to use food as a coping mechanism, whereas men tend to use nicotine or alcohol.[11,12] The association between stress-related eating and obesity is also stronger among women than men.[13] Women also are more likely than men to engage in dietary restraint, which can be defined as the self-regulatory behavior of restraining caloric intake to lose or maintain weight, due to societal pressures to be thin.[14] Dietary restraint, especially among those who have a tendency to overeat, may trigger compensatory eating, and thus beget a cycle of overeating.[15] Being overweight may also increase the risk of stress-eating behavior, as the stress related to weight stigma may be a trigger.[16]

Additionally, in the absence of adaptive stress coping mechanisms, such as physical exercise, one may be more likely to engage in stress eating.[17]

Since chronic stress is a key factor in stress-eating, stress reduction strategies are essential for successful treatment. Mindfulness, both a key component of Acceptance Commitment Therapy (ACT) and Dialectical Behavior Therapy (DBT), encourages regulating eating habits by increasing awareness to internal hunger and satiety cues and to sensory responses while eating.[18] Guided meditations to increase awareness and identify eating triggers is also a key element in mindfulness-based interventions. Mindfulness-based approaches are effective in addressing dysregulated eating in both subclinical and clinical populations.[19]

CLINICS CARE POINTS

- Stress eating or emotional eating is a coping mechanism for chronic stress and is characterized by the ingestion of calorically dense and highly palatable foods.
- Stress eating behavior plays a role in unintended weight gain and the obesity epidemic.
- Chronic stress can trigger the release of cortisol, which can induce overeating of energy-dense foods.
- Women are more likely than men to use food as a coping mechanism for stress and to engage in dietary restraint.
- Being overweight may increase the risk of stress-eating behavior due to weight stigma.
- Stress reduction strategies, such as mindfulness-based approaches, can be effective in addressing dysregulated eating in both subclinical and clinical populations.

PATHOLOGICAL EATING AND EATING DISORDERS

In some cases, stress or emotional eating can lead to binge eating disorder (BED). BED is characterized by recurrent episodes of binge eating (BE; ie, occurring once per week over a 3-month period) during which individuals consume large amounts of food within a distinct period of time (ie, 2 hours) and experience a sense of loss of control over their eating. Those with BED are markedly distressed by BE episodes but refrain from using extreme compensatory behaviors (ie, self-induced vomiting, laxative misuse) between episodes.[20] Though not central to the diagnosis, BE episodes tend to occur during the evening hours.[21,22] BED is the most commonly diagnosed eating disorder, with lifetime prevalence rates of 3.5% for women and 2.0% for men.[23] Most individuals with BED are either overweight (BMI: 25–29.9) or obese (BMI: 30+).[24] The diagnosis is associated with numerous psychological and medical comorbidities, including overweight and obesity.[23]

Though the eating pattern exhibited by individuals with BED is distinct from those of anorexia and bulimia nervosa, the three major eating disorders share the same underlying psychopathology: an over-evaluation of the importance of shape and weight—and an individual's corresponding ability to control these factors—when determining one's self-worth. Across presentations, this emphasis leads to attempts to restrain or reduce one's eating, the severity of which differs by diagnosis.[25] The front-line treatment of eating disorders, including BED, is cognitive-behavioral therapy-enhanced (CBT-E),[24] a time-limited, transdiagnostic, yet individualized treatment of eating disorder psychopathology. When used to treat BED, CBT-E consists of 20 treatment sessions across 20 weeks and can be administered in either an individual or group format.

BED treatment consists of 4 distinct stages.[25] Stage one involves intensive twice-weekly sessions during which the provider constructs an individualized client case conceptualization, provides psychoeducation about treatment, and introduces the client to the main tenets of CBT-E: weekly in-session weight assessments and the establishment and ongoing self-monitoring of a regular eating pattern (ie, 3 meals and 3 snacks per day) to disrupt attempts at dietary restraint. Within the CBT-E framework, these attempts—and subjective "failures" to maintain this restraint—are posited as the practice that perpetuates binge eating episodes. Stage 2 is a transitionary stage during which the provider assesses client momentum and self-monitoring records in order to detect any barriers to weekly weighing and/or adherence to a regular eating pattern. Stage 3 consists of 8 weekly sessions of individualized treatment during which the provider and client work collaboratively to evaluate the negative consequences of the overemphasis on shape and weight, bolster the relative importance of other domains when assessing self-worth (eg, relationships, school, work, hobbies) and address other potential BED maintenance factors, including self-imposed dietary rules, event or mood-related changes in eating, negative body image, low self-esteem, clinical perfectionism, and interpersonal problems. The fourth and final stage of treatment consists of 2 biweekly sessions that prepare the client for future success by reviewing the maintenance of treatment gains, identifying realistic goals for continued improvement, and developing a plan for any anticipated obstacles. Typically, a follow-up session occurs approximately 20 weeks after treatment completion to review the client progress. CBT for BEDs yields transdiagnostic remission rates of no more than 50%, rendering it only marginally more efficacious than, if not equal to, other treatments for eating disorders.[26,27] However, it remains the most extensively studied and evidence-informed treatment of EDs to date.[28]

CLINICS CARE POINTS

- Binge eating disorder (BED) is characterized by recurrent episodes of binge eating and a sense of loss of control over eating, occurring at least once per week over a 3-month period.
- BED is the most commonly diagnosed eating disorder, with a lifetime prevalence of 3.5% for women and 2.0% for men.
- Most individuals with BED are either overweight or obese.
- The underlying psychopathology of BED, as well as other eating disorders, is an overevaluation of the importance of shape and weight in determining self-worth.
- The front-line treatment of BED is cognitive-behavioral therapy-enhanced (CBT-E), which consists of 4 stages and 20 treatment sessions over 20 weeks.
- CBT-E can be administered in either an individual or group format and aims to disrupt attempts at dietary restraint, evaluate the negative consequences of an overemphasis on shape and weight, bolster the relative importance of other domains in assessing self-worth and address other potential BED maintenance factors.
- CBT-E yields transdiagnostic remission rates of no more than 50% and is the most extensively studied and evidence-informed treatment of eating disorders.

CIRCADIAN CLOCK AND METABOLISM

A particularly modern source of chronic stress is the increase in light at night, shift work, and the availability of high-caloric foods in abnormal feeding times. These

sources of chronic stress can lead to circadian dyssynchrony which has particularly dire metabolic consequences.[29] The human body functions with an endogenous timekeeping system driven by internal molecular clock mechanisms and environmental entrainment cues such as light and feeding. The term circadian, derived from Latin "circa" (about) and "diem" (day), was first introduced in the 1950s as a means of defining this system. Mammalian innate physiology is influenced by rhythms organized with near 24-h periodicity.[30–32] This circadian clock is an integral component of human function, with about 80% of all protein-coding genes displaying circadian expression,[33] including the majority of genes encoding pharmaceutical drug targets.[34] Alterations in the circadian clock can lead to states of disequilibrium with implications for aging and disease risk on a molecular level.[35] Indeed, specific polymorphisms in circadian clock genes (eg, CRYPTOCHROME genes, PERIOD genes, CLOCK) are associated with obesity and poor weight loss in response to various therapies including bariatric surgery.[36,37]

The influence of circadian rhythms on metabolism has been an area of extensive investigation. Animal models with disruptions in circadian rhythms lead to metabolic pathophysiology.[32] Various environmental cues can augment endogenous timekeeping. The most significant modulator is light,[38] but others such as food intake independently alter peripheral body circadian rhythms, particularly of metabolically important organs such as the intestines, liver, and muscles.[39] When behaviors (sleeping, physical activity, eating/drinking) are mistimed within the normal 24-h day cycle this can lead to circadian misalignment. One way which the interplay between metabolism and circadian misalignment has been studied is by examining the impact of shift work on body metabolism.

CLINICS CARE POINTS

- Chronic stress, such as that caused by light at night, shift work, and abnormal feeding times, can lead to circadian dyssynchrony, which has negative consequences for metabolism.
- The human body has an endogenous timekeeping system (circadian clock) that is influenced by internal molecular mechanisms and external cues such as light and feeding.
- Alterations in the circadian clock can contribute to the development of aging and disease.
- Specific genetic variations in circadian clock genes have been linked to obesity and poor weight loss in response to various therapies, including bariatric surgery.
- The influence of circadian rhythms on metabolism has been widely studied, and disruptions in these rhythms can lead to metabolic pathophysiology.
- Environmental cues, including light and food intake, can alter the circadian rhythms of metabolically important organs such as the intestines, liver, and muscles.
- Mistiming behaviors such as sleeping, physical activity, and eating can lead to circadian misalignment, which has been studied in the context of shift work and its impact on body metabolism.

SHIFT WORK AND OBESITY AND OBESITY-RELATED DISEASES

Shift work is a particularly modern source of chronic stress that can disrupt the body's natural circadian rhythms. Shift-based workers often engage in atypical sleep/wake cycles based on the scheduling needs of their occupation. The misalignment caused by shift-work has been linked to negative consequences for metabolism and disease risk. This form of circadian disruption has been associated with adverse health events,

including cardiovascular disease, and metabolic syndrome.[29] There is a strong association between shift work and risk of overweight and obesity.[40] Night shift work in particular is associated with the increased risk of obesity/overweight and shift workers had a higher frequency of developing abdominal obesity rather than other obesity types.[41] Having ever worked a night shift is associated with increased risk for metabolic syndrome; higher cumulative years of night shifts was associated with progressively higher risk.[42]

Studies evaluating the association between sleep/duration and obesity-related disorders, in particular nonalcoholic fatty liver disease (NAFLD), have yielded varying results. Studies have shown that sleep duration <5 hours[43,44] and <6 hours[45] increased the risk of NAFLD among women; sleep duration <5 hours increased the risk of NAFLD and obesity in men compared to >7 hours which was associated with lower risk for NAFLD/obesity.[46] However, long sleep duration (>9 hours) was associated with a modestly increased risk of NAFLD in both men and women.[47] Poor sleep quality was associated with increased risk for NAFLD among both men and women[44]; and poor sleep quality predicted up to 20% of variability in liver stiffness among obese men and women with NAFLD.[48] Overall, although there are associations between sleep variability and increased risk for metabolic derangements, the specifics of this interplay require further investigation. Still, these relationships between shift work and sleep variability with obesity exemplifies the impact circadian dysregulation can have on metabolism.

CLINICS CARE POINTS

- Shift work is a modern source of chronic stress that can disrupt the body's natural circadian rhythms and lead to negative consequences for metabolism and disease risk.
- Shift work has been associated with an increased risk of overweight and obesity, particularly among those working night shifts.
- Shift work has also been linked to an increased risk of metabolic syndrome.
- The relationship between sleep variability and increased risk for metabolic derangements, including obesity and NAFLD, is not fully understood but requires further investigation.
- It is important to consider the role of circadian rhythms in the development and management of chronic stress, especially among shift workers, in order to minimize negative health outcomes.

THERAPEUTIC APPROACH: TIME-RESTRICTED EATING

The impact of shift work on metabolism and the risk of obesity and related disorders highlights the importance of addressing circadian dysregulation. One approach that has shown promise in this regard is time-restricted eating (TRE), which involves restricting food intake to specific periods of the day in order to synchronize the body's internal clock with the external environment. TRE refers to the dietary intervention of limiting food consumption to a specific time window each day. The goal of TRE is the correction of circadian dyssynchrony by aligning feeding times to more active periods of central circadian rhythms. TRE is one of the many modalities of intermittent fasting, which encompasses dietary interventions that limit the timing, rather than content, of food intake.[30,49]

Early studies investigating the timing of food intake have shown that many individuals do not eat 3 discrete meals a day but rather are constantly grazing with an

expanded window of caloric consumption.[3] Several studies have investigated the effects of TRE on metabolism-related health outcomes. Some key findings from extended duration (>4 weeks) randomized-controlled trials are summarized in **Table 1**. In all, the weight loss outcomes from TRE tend to be modest with only 2% to 3% TBWL in long-term clinical trials.[30] However, these clinical trials demonstrate that TRE can lead to improvements in insulin sensitivity, blood pressure, and oxidative stress in men with prediabetes[50]; improved blood glucose and insulin sensitivity in overweight adults with type 2 diabetes mellitus[51]; weight loss in overweight women[52]; weight loss and improved fasting blood glucose in obese men and women when combined with a commercial weight loss program[53]; weight loss with improved diastolic blood pressure and improved mood[54]; and significantly greater loss of fat in overweight/obese individuals when combined with concurrent exercise training.[55] Yet, some studies have found that TRE does not improve metabolic outcomes despite causing weight loss. For example, one study noted that TRE led to a reduction in fat mass in patients with NAFLD, but did not alter liver stiffness, insulin sensitivity, or LDL/HDL.[56] Another study showed that TRE reduced weight and frequency of eating but did not improve metabolic endpoints such as A1C, insulin sensitivity, or lipid measures.[57] One RCT of middle-aged women found that TRE increased fasting glucose and insulin resistance despite causing weight loss.[58]

In contrast to some studies that have found TRE to have modest benefits on metabolic outcomes, other RCTs have observed no such effects. A recent trial found no difference between groups in the primary outcome of weight change from baseline, nor in secondary outcomes such as waist circumference, insulin sensitivity, and serum lipids.[59] However, it is worth noting that this study did not adequately track food intake and the authors reported that the control group voluntarily restricted their food intake, which may complicate the interpretation of the results. Another RCT found no significant difference in weight change or secondary metabolic outcomes between the TRE group and the control group, which followed a consistent-meal timed diet with 3 structured meals and allowed for light snacking in between.[60]

Like other dietary and behavioral interventions, the success of patients using TRE will likely depend heavily on their adherence to the prescribed eating schedule. Moreover, it is not clear whether these benefits are due to the change in eating schedule itself or to the resulting caloric restriction that occurs when people adhere to this schedule,[61–63] or whether they are particularly beneficial to shift workers. Only a single study has investigated the effects of TRE on shift workers.[64] Early results from a study of firefighters who work 24-h shifts concluded that a 10-h TRE protocol significantly increased quality of life metrics, and in patients with cardiometabolic risk factors, decreased VLDL, and improved hemoglobin A1c and diastolic blood pressure.

More studies are needed to determine the optimal duration and timing of TRE that would increase the chances of desired metabolic outcomes and to better understand its effects on metabolism-related health outcomes. Mouse studies suggest that changes in the gut microbiome may play a role in the metabolic effects of time-restricted diets.[65,66] For example, certain methods that mimic the changes in the microbiome caused by TRE improve glucose tolerance without affecting mouse weights.[67] However, our understanding of the relationship between chronic stress, circadian disruption, and metabolism is incomplete, and further research may identify new therapeutic targets for reversing the negative metabolic effects of chronic stress.

Table 1
Randomized control trials on time-restricted eating

Article	Intervention	Control	Population	Key Findings
Jamshed et al,[54] 2022	TRE (7:00–15:00) with energy restriction diet and exercise counseling for 14 wk	Energy restriction diet and exercise counseling	Men and women aged 25–75 y with obesity following in weight management clinic at the University of Alabama at Birmingham hospital (N = 90)	TRE was more effective for losing weight and improving diastolic blood pressure and mood than eating over a window of 12 or more hours at 14 wk.
Sutton et al,[50] 2018	TRE (6-h eating window, dinner before 15:00) for 5 wk followed by 7 wk washout and crossover	12-h eating period with matched food intake	Men with prediabetes (N = 12)	TRE did not improve weight loss but improved insulin sensitivity, β cell responsiveness, blood pressure, oxidative stress, and appetite.
Che et al,[51] 2021	TRE (8:00–18:00) for 12 wk	Unrestricted eating	Overweight men and women with type 2 diabetes (N = 60)	TRE led to significant decreases in body weight, A1C, and in hyperlipidemia
Domaszewski et al,[52] 2022	TRE (12:00–20:00) for 6 wk	Unrestricted eating	Overweight or obese women over age 60 (N = 45)	TRE led to weight loss (approximately 2 kg) with decreases in BMI and weight, with 88% of participants adherent to the TRE diet
Peeke, et al,[53] 2021	TRE (10 h) starting after dinner between 17:00 and 20:00) on a commercial weight loss program diet with a snack at fasting hour 12 for 8 wk	TRE (12 h) starting after dinner between 17:00 and 20:00 on a commercial weight loss program diet	Obese men and women (N = 60)	Those on 10 h TRE diet + fasting snack had slightly more weight loss (11 kg compared to 9 kg), with a significant reduction in fasting blood glucose only in the 10 hr TRE study arm

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Table 1
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Article	Intervention	Control	Population	Key Findings
Kotarsky et al,[55] 2021	TRE (12:00–20:00) for 8 wk combined with aerobic and resistance training	Normal diet combined with aerobic and resistance training	Overweight and obese men and women (N = 21)	TRE led to more weight loss, specifically greater loss of fat mass
Cai et al,[56] 2019	TRE (8 h eating window) for 12 wk	80% of energy needs consumed via otherwise unrestricted diet	Men and women aged 18–65 y with NAFLD (N = 271)	TRE led to a reduction in body weight and fat mass and serum triglycerides
Chow et al,[57] 2020	TRE (8 h eating window) for 12 wk	Unrestricted eating	Obese men and women (N = 20)	TRE led to reduced weight and fat mass, without impact on metabolic markers
Isenmann et al,[62] 2021	TRE (12:00–20:00) for 14 wk	Macronutrient-based diet	Overweight or obese (class I) adults aged 20–40 years old exercising at least twice per week (N = 35)	Both TRE and macronutrient-based diet led to weight loss, with higher adherence in the TRE group
Liu et al,[59] 2022	TRE (8:00–16:00) with calorie restriction for 12 mo	Calorie-restricted diet alone	Men and women with obesity (N = 118)	TRE with calorie restriction did not lead to significant changes in body weight, fat, or metabolic risk factors compared to calorie restriction alone
Lowe et al,[60] 2002	TRE (12:00–20:00) for 12 wk	3 structured meals per day without time restriction	Overweight or obese men and women aged 18–64 (N = 116)	TRE did not lead to greater weight loss or improvement in secondary metabolic endpoints compared to structured meal intake

Lin et al,[58] 2022	TRE (8 h eating window) with low-calorie diet for 8 wk	Low-calorie diet	Overweight or obese women aged 40–65 (N = 63)	TRE with low-calorie diet led to more weight loss and decease in diastolic blood pressure compared to low-calorie diet alone, but higher fasting glucose and insulin resistance were noted in the TRE arm
Phillips et al,[63] 2021	TRE (12 h eating window) for 6 mo	Standard dietary advice with unrestricted eating	Adults with eating duration >14 h and one component of metabolic syndrome	TRE did not lead to a significant difference in weight loss achieved with standard dietary advice
Thomas et al,[61] 2022	TRE (10 h eating window) starting within 3 h of waking with daily caloric restriction for 12 wk	Daily caloric restriction	Overweight or obese men and women (N = 81)	TRE did not lead to any difference in weight loss at 12 or 39 wk or metabolic markers

CLINICS CARE POINTS

- Time-restricted eating (TRE) involves limiting food intake to specific periods of the day to synchronize the body's internal clock with the external environment.
- TRE is a form of intermittent fasting that limits the timing of food intake rather than the content.
- TRE has been shown to have modest weight loss effects in long-term clinical trials, with a 2% to 3% reduction in total body weight loss (TBWL).
- TRE has been linked to improvements in insulin sensitivity, blood pressure, and oxidative stress in men with prediabetes; improved blood glucose and insulin sensitivity in overweight adults with type 2 diabetes mellitus; weight loss in overweight women; weight loss and improved fasting blood glucose in obese men and women when combined with a commercial weight loss program; and significant fat loss in overweight/obese individuals when combined with concurrent exercise training.
- TRE may be of particular benefit to those who are shift workers.
- More research is needed to determine the optimal duration and timing of TRE, its effects on metabolism-related health outcomes, and whether it is particularly beneficial for shift workers.
- Further research is needed to understand the relationship between chronic stress, circadian disruption, and metabolism and to identify potential therapeutic targets for reversing the negative metabolic effects of chronic stress.

SUMMARY

Environmental factors, including diet and stress, can contribute to the development of obesity. Stress-related eating patterns, such as consuming high-calorie foods in excess and eating late at night, may contribute to weight gain. Disruptions to the body's natural circadian rhythms, such as those experienced by shift workers, may also contribute to obesity and metabolic syndrome. While more research is needed to determine the effectiveness of time-restricted eating for obesity management, stress reduction and mindfulness techniques, as well as cognitive-behavioral therapy, have been found to be helpful in addressing disordered eating behaviors, including Binge Eating Disorder.

DISCLOSURES

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