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Outcomes of different types of intermittent fasting for practitioners in terms of nutritional status and quality of life: A systematic review

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ABSTRACT

Intermittent fasting (IF) is a method of restricting energy intake or shortening the period of feeding of an individual. It is one of the dietary strategies that have been developed to treat overweight and obesity and has become popular and widely adopted. IF diets have several different types. Thus, this study aims to review the outcomes of different types of IF for practitioners in terms of their nutritional status and quality of life (QoL). Electronic databases (ScienceDirect and Wiley Online Library) were used to search for relevant articles. The keywords used were "IF" OR "intermittent energy restriction" OR "time-restricted feeding" OR "alternate day fasting" OR "5:2 diet" AND ("energy intake" OR "caloric consumption") AND ("nutritional status" OR "health condition") AND ("QoL" OR "changes in lifestyle"). Nutritional status outcomes highlighted that most people following IF diets were able to reduce weight, fat mass, and waist circumferences. IF also improved the lipid profile, fasting blood glucose, insulin, and blood pressure. As for the QoL, some studies highlighted improvements in emotional well-being after the trials; however, inconsistent results were obtained in terms of the physical activity domain. Different geographical areas covered in the articles reviewed might contribute to inconsistent findings related to the physical activity domain and thus become a limitation in this review. In conclusion, IF intervention, regardless of type, was able to show improvement in anthropometry and QoL.

INTRODUCTION

Obesity is no longer a silent "trouble bearer" in today's era. In fact, it is strongly associated with hypertension, heart disease, and diabetes mellitus (Powell-Wiley *et al*., 2021). Based on obesity prevalence reported by Jebeile *et al*. (2022), obesity plateaued in many high-income countries before the COVID-19 pandemic and has risen in middle-income countries. Based on gross national income per capita in 2019, Malaysia is classified as an upper-middle-income country. According to the National Health and Morbidity Survey 2019, Malaysians gained more weight in 2019, with 52.6% of adults suffering from abdominal obesity, a rate higher than 48.6% in 2015. The prevalence of obesity in adults also increased from 17.7% (or 3.3 million Malaysians) in 2015 to 19.7% in 2019. Overweight increased marginally, from 30% in 2015 to 30.4% in 2019.

The alarming trend of the obesity epidemic requires not only an immediate revision of public health policies but also a supportive environment for communities to work toward a healthier lifestyle practice (Freire, 2020). Effective health promotion intervention is thus appropriate for any age range. This requires comprehensive contextual knowledge of the health status of the target population and the prevalence of the risk factors for which the intervention is directed (Millarini *et al*., 2019). Along with the various dietary strategies developed to treat overweight and obesity, intermittent fasting (IF) had been recorded as the most preferable dietary method, because it is easy to comply with daily life. Energy restrictions are only required intermittently with a diet that allows normal eating on a non-fasting day (Mosley and Spencer, 2015). The IF diet has gained attention among obese people for weight loss management as they have shown significant improvements in body composition, cardiometabolic profile, emotional eating, quality of life (QoL), vascular function, and structure (Lister *et al*., 2020). IF has been described as periods

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of voluntary abstinence from food and drink (Patterson *et al*., 2015). IF diets also have been associated with both weight loss and a reduced risk of various major health conditions (Potter *et al*., 2019) as periods of voluntary abstinence from food and drink (Patterson *et al*., 2015).

Different types of IF diets promote different approaches in terms of calorie intake (Parvaresh *et al*., 2019) and fasting durations (Rynders *et al*., 2019), which then produce different outcomes toward nutritional status (Harvey *et al*., 2018) and QoL of practitioners (Engebretsen *et al*., 2016). Hence, this study aims to review the various types of IF diet approaches and dietary outcomes in terms of calorie intake, nutritional status, and QoL.

METHODOLOGY

A systematic literature search was performed based on Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines (Fig. 1). The two databases used were ScienceDirect and Wiley Online Library, using the keywords "IF" OR "intermittent energy restriction (IER)" OR "time-restricted feeding (TRF)" OR "alternate day fasting" OR "5:2 diet" AND ("energy intake" OR "caloric consumption") AND ("nutritional status" OR "health condition") AND ("QoL" OR "changes in lifestyle"). A total of 1,644 articles were yielded throughout the databases. Title/abstract/keywords screening was performed independently by the researchers to identify articles of interest.

The inclusion criteria for this review were (1) a published retrospective, prospective, or randomized controlled trial study; (2) a human-based study; (3) a trial of IF; (4) available data on nutritional status and/or QoL. Data such as study population and demographics and outcome measures were extracted. Seventh-day Adventists and Ramadan fasting are two examples of religious practices that are excluded in the present review because their eating habits are not health-conscious and are often investigated using observational approaches.

RESULTS

A total of 21 articles were systematically reviewed. Six articles were reviewed regarding IER (Table 1); six articles were reviewed regarding TRF (Table 2); six articles were reviewed regarding alternate days fasting (ADF) (Table 3); and three articles were reviewed regarding the 5:2 diet (Table 4).

In terms of anthropometric parameters, all the IF types were able to show a reduction in body weight, waist circumference, and body fat mass. The 5:2 diet was the only IF reviewed that has two stages in monitoring weight. The first stage is to reduce body weight and the second stage is to maintain the gained weight. IF, regardless of type, was also able to improve diabetic-related parameters [decreases fasting blood glucose, increases insulin sensitivity, and improves homeostasis model assessment-estimated insulin resistance (HOMA-IR)]. Some studies have reported increases in insulin, while some studies reported decreases in insulin after IF trials. These increases or decreases in insulin might be due to the body trying to control the blood glucose of the participants during that time.

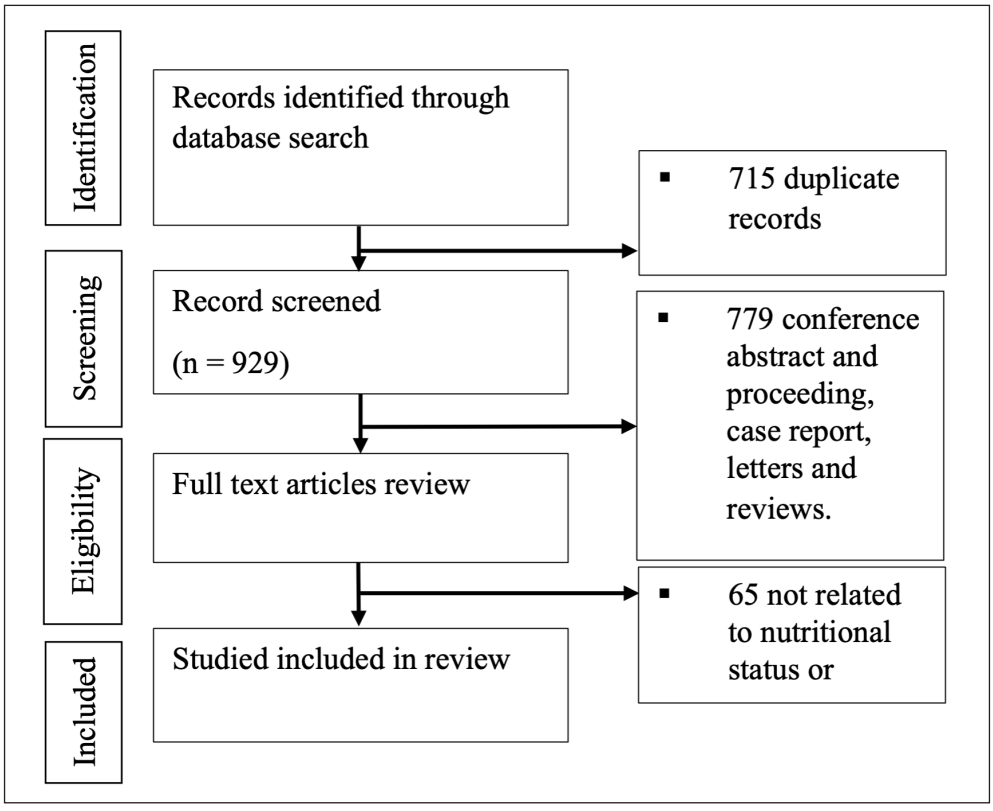

Figure 1. PRISMA flow diagram summarizing the studies identified during the literature search and abstraction process.

Table 1. Summary of IER outcomes in terms of nutritional status and QoL.

Author	Subject overview	Duration	Outcome	
			Nutritional status	QoL
Hutchison *et al.* (2019)	Australia, women, *n* = 55/46; 35–70 years old	10 weeks	• Weight loss, reduced waist circumferences, fat mass • Changes in glucose and insulin in IF diet 70% of the baseline energy requirement (IF70) HOMA-IR improved in IF70 Fasting insulin increased in IF diet 100% of the baseline energy requirement (IF100)	N/A
Wegman *et al.* (2015)	U.S., healthy individual, *n* = 24/ 22; 19–30 years old	10 weeks	• Increase NAD-dependent deacetylase sirtuin-3, mitochondrial, SIRT3 expression (+2.71%) • Insulin level reduction (−1.01 μU/m) Absence in weight loss	• Food intake improved
Zuo *et al.* (2016)	U.S., obesity individual, *n* = 40/40; (mean age = 48.0 ± 1.4)	12 weeks	• Weight loss and decreased BMI • Decreassed in heart rate, blood pressure, TG, LDL-c, and TC	• Physical activity improved • Well-balanced diet intake
Arciero *et al.* (2016)	New York, obese men (*n* = 21) and women (*n* = 19), *n* = 43/40; aged 18–57 years old	6 months	• Reduced weight (10%), total body fat (19%), abdominal body mass (25%) and visceral adipose tissue, VAT (33%), and increased lean body mass (9%) • Fasting glucose dropped by 12% and 7%, insulin by 40% and 42% in men and women. Resting metabolic rate (RMR) unchanged	• Improved metabolism, physical activity, and hunger ratings
Coutinho *et al.* (2018)	Norway, obese adults, *n* = 18/14; 18–65 years old	12 weeks	• Reduced weight (12.5%), fat mass (38.5% ± 2.0%), free-fat mass, (61.5% ± 1.6%) • Improvement in RMR (1,368 ± 55 kcal/day)	• Increased physical activity • Improved appetite
Barnosky *et al.* (2017)	Chicago, overweight and obese subjects, *n* = 66/60; 18–65 years old	6 months	• Reduced weight and fat mass • Improve in circulating insulin-like growth factor-1, ($p < 0.0001$)	• Physical activity did not change

After IF trials, the blood pressure of participants generally decreased. Only two studies in TRF did not report any changes in blood pressure. This might be due to the duration of intervention which is less than 2 months, and the focus of the study was not on cardio-metabolic parameters. A few studies highlighted that IF could affect brain-derived neurotropic factors and gene expression. However, recent studies regarding this need more study. In terms of QoL, IF improved food intake and appetite. The participants stated that the intake of diet after the trials was improved. Other than that, improvements in terms of emotional well-being were reported after the IF trials regardless of the type of fasting.

DISCUSSION

This review showed that different types of IF managed to have similar effects on nutritional status and QoL. The types of IF that have been reviewed were IER, TRF, ADF, and the 5:2 diet. Ramadan fasting could theoretically be classified as IF as it also involves voluntary abstinence from or reduction of some or all food, drinks, or both (absolute) for a period of time lasting (Lessan and Ali, 2019). However, it could only be done in specific months of the year, which is Ramadan month according to the Islamic calendar, also known as lunar month in the lunar calendar. Therefore, Ramadan fasting was excluded in this review as the main focus was the type of fasting that could be done at any time throughout the year.

Each IF was different in terms of its protocol or dietary pattern. However, a fixed pattern for calorie intake during fasting has yet to be established. A researcher or individual could manage their pattern for calorie intake according to their body condition, schedule, or research objective. Based on the present review, each IF recorded several participants dropping out due to various reasons, along with non-compliance with the dietary patterns suggested during the trials. The highest dropout rates in IF were as follows: IER, 22.2% (Coutinho *et al*., 2018); TRF, 33.3% (Sutton *et al*., 2018); ADF, 40.4% (Kalam *et al*., 2019); they were related to very low-calorie diets or diets low in carbohydrates (Coutinho *et al*., 2018; Kalam *et al*., 2019). This finding was supported by Hemmingsson *et al*. (2012), who mentioned a very low-calorie diet or low-calorie diet results in 18% and 23% dropout rates during commercial weight-loss programs. Therefore, it is best to choose a pattern suitable to one's body condition or to use a very low-calorie diet in a 5:2 diet to increase compliance among participants. The 5:2 diet is suitable for use on a very low-calorie diet because the fasting days only include 2 days per week. This diet style might not burden the body too much.

Table 1 shows that IER could improve the nutritional status and QoL. In the IER assessment, most of the nutritional

Table 2. Summary of TRF the outcomes in terms of nutritional status and QoL.

Author	Subject overview	Duration	Outcome	
			Nutritional status	QoL
Lee *et al*. (2020)	US, overweight adult, *n* = 10/9; 65 and older	4 weeks	N/A	• Feeling discomfort in doing daily activities but manageable
Moro *et al*. (2016)	Italy, resistance-trained male, *n* = 34/34; (age 29.21 ± 3.8)	8 weeks	• Significant decrease in fat mass (−16.4%), blood glucose (−10.72 ± 2.0 mg/dl), insulin levels (−1.01 ± 0.3 ng/ml) • Adiponectin increase, leptin decrease • Triiodothyronine decreased • Improvement in HOMA-IR • Improved insulin sensitivity and beta-cell responsiveness by 14 ± 7 U/mg	• Increase strength by working out or any physical activity
Sutton *et al*. (2018)	US, men with prediabetes, *n* = 12/8; (aged 56 ± 9 years)	5 weeks	• SBP and DBP lowered by 11 ± 4 mmHg and 10 ± 4 mmHg, respectively • Plasma levels of 8-isoprostane decreased (by 11 ± 5 pg/ml)	• Improved appetite
McAllister *et al*. (2020)	US, obese and overweight men, *n* = 22/21; (aged 22 ± 2.5years)	28 days	• Reduction in body mass ($p < 0.001$) • *Ad libitum*: fat percentage (−14.5% ± 4.3%), fat mass (−25.7 ± 19.3 kg), SBP (−119 ± 11 mmHg) • Isocaloric: fat percentage (−13.6% ± 4.2%), fat mass (−16.4 ± 8.2 kg), SBP (−114 ± 10 mmHg)	• Improved food intake
Jamshed *et al*. (2019)	Birmingham, overweight adults, *n* = 11/11; 20–45 years old	4 days	• Decreased mean 24-hour glucose levels by 4 ± 1 mg/dl ($p = 0.0003$) and glycemic excursions by 12 ± 3 mg/dl ($p = 0.001$) • Increase brain-derived neurotropic factor, BNDF ($p = 0.10$) • Increased expression of mammalian target of rapamycin ($p = 0.007$)	Altered the diurnal patterns in cortisol and the expression of several circadian clock genes ($p < 0.05$)
Anton *et al*. (2019)	US, overweight adults, *n* = 10/9; 65 years old and older	4 weeks	• Weight loss was 2.6 kg ($p < 0.01$)	• Increase in walking speed of 0.04 m/seconds • Improvements of 5%–8% in the mental and physical health domains of the SF-12 • Improved perceptions of physical function and ability to perform daily activities.

status highlighted is the reduction of weight, fat, and waist circumferences. One of the studies included by Wegman *et al*. (2015) reported a lack of weight loss. This is due to overeating during the feast day that was suggested in the study. Other than positive effects on weight management, the studies reviewed showed an improvement in blood pressure, cholesterol levels, fat levels, and glucose metabolism. As far as QoL is concerned, only Hutchison *et al*.'s (2019) study did not report any outcomes or progress in improving the QoL. As for the other four studies, the QoL of the participants improved in terms of physical activity, eating behavior, and emotional well-being, while Barnosky *et al*. (2017) described that there was no change in physical activity even after IER trials.

Furthermore, shows the effects of different TRF on nutritional status and QoL. Three out of six studies showed a greater effect on the reduction of body mass, fat, and blood pressure. In Lee *et al*.'s study (2020), no nutritional status data were reported at the end of the study. This is because the aim of the study is to monitor the level of adherence among elderly people aged 65 years and older on TRF dietary assessments instead of weight management or any health improvement. As for Sutton *et al*. (2018), there was a lack of weight loss due to a short 4-day TRF intervention trial. According to the study, no change in body weight was due to the reduction in glycogen levels and the accompanying loss of water weight resulting from the longer duration of fasting on the TRF schedule. The suggested diet assessments enhance

Table 3. Summary of ADF outcomes in terms of nutritional status and QoL.

Author	Subject overview	Duration	Outcome	
			Nutritional status	QoL
Bhutani *et al*. (2018)	Chicago, overweight and obese adults, *n* = 65/44; 18–65 years old	1 year	• 1st 6 months: 6% weight loss, HDL-c increase (6.2 mg/dl) • 2nd 6 months: weight maintained, LDL-c increase (11.5 mg/dl) • 1st 3 months: Body weight (−5.5 % ± 0.5%), fat mass ($p < 0.01$) and lean mass decreased ($p = 0.01$)	• Improvement in physical component QoL
Kalam *et al*. (2019)	Chicago, pre-menopausal or postmenopausal women, *n* = 52/31; 18–65 years old	6 months	• HDL-c decreased ($p = 0.01$), • DBP decreased (−5 ± 3 mm Hg), • Fasting insulin decreased (−16% ± 6%) • 2nd 3 months: TC (−6 % ± 2%) and LDL -c (8 % ± 3%) reduced, SBP decreased (−7 ± 3 mmHg)	• Improve in physical activity by achieving 8,000 steps/day
Parvaresh *et al*. 2019)	Iran, patient with metabolic syndrome (Mets), *n* = 35/35; 25–60 years old	8 weeks	• Reduction in body weight (−4.1 ± 3.65 kg), waist circumference (−4 ± 4.09 cm), • SBP reduction (−13 ± 4.0 mmHg), fasting plasma glucose (−5 ± 6.82 mg/dl)	• Improvement in physical activity and eating behaviors
Catenacci *et al*. (2016)	Colorado, adults with obesity, *n* = 14/13; 18–55 years old	8 weeks	• Decreased in body weight (−8.2 ± 0.9 kg), fat mass (−0.4 ± 0.8 kg)	N/A
Dayanand (2018)	US, obese participants, *n* = 17/17; 18–65 years old	12 months	• Body weight change by month 12 ranged from +3.7% to −4.7% (mean −0.9% ± 0.6%) in the low-weight-loss group, and −5.5% to −17.5% (mean −9.9% ± 1.1%) in the high-weight-loss group • Reduction in weight by −7.3% ± 0.9% than the control group	• Eating behavior traits: hunger rating decreased and fullness rating increased
Trepanowski *et al*. (2018)	Chicago, overweight and obese men and women, *n* = 34/28; 18–65 years old	24 weeks	• Reduction in VAT (−24 % ± 4%) • The fat-free mass: total mass ratio increased (0.03 % ± 0.00) • Reduction in insulin (−42 % ± 12%), HOMA-IR (−45 % ± 13%), and leptin (−18 % ± 6%)	• The physical activity of the participants does not increase throughout the trials

Table 4. Summary of the 5:2 outcomes in terms of nutritional status and QoL.

Author	Subject overview	Duration	Outcome	
			Nutritional status	QoL
Conley *et al*. (2018)	Australia, male war veteran, *n* = 24/23; 55–57 years old	6 months	• Reduction in weight (−5.3 ± 3.0 kg) and waist circumference (−8 ± 10 cm) • Reduction in SBP (14 mmHg)	• Improvement in psycho-social score
Fitzgerald *et al*. (2018)	US, Multiple sclerosis patient, *n* = 24/23; 18–50 years old	8 weeks	• Weight loss at the end of trials • Reduction in fat and lean mass with −119.8 g/week. • Decline in cholesterol level	• Improvement in emotional well-being scores
Antoni *et al*. (2020)	Europe, obese patient, *n* = 99/27; 18–65 years old	6 months	• Reduction in weight by 2.0% ± 0.4% • Waist circumferences reduction by −1.6 cm and fat mass reduction by −2.7 kg • HDL-c ($p = 0.007$) and TG ($p = 0.008$) increased. • SBP reduction (− 8.6 mmHg)	N/A

participants' QoL by enhancing their mental health and daily dietary intake, encouraging them to maintain a well-balanced diet throughout their daily lives. There has also been an improvement in the physical activity of the participants in terms of endurance during a workout, walking steps, and physical function. Based on the studies that have been reviewed, it can be concluded that the TRF diet intervention does improve the nutritional status and QoL even in a short study, especially among obese and overweight participants.

Based on this review, the ADF studies showed positive results in the nutritional status, especially in the reduction of body weight after the trials in Table 3. In Kalam *et al*.'s study (2019), an ADF low-carbohydrate diet was implemented in subjects and appeared to be effective in helping individuals maintain their weight loss. The study duration of Parvaresh *et al*. (2019) and Catenacci *et al*. (2016) is the same as that of 8 weeks. Therefore, the differences might be due to the different types of subjects. While Catenacci *et al*. (2016) used obese people without any cardiometabolic disorders as their subjects, Parvaresh *et al*. (2019) used metabolic syndrome patients who were actively receiving medical treatment. Hence, the study of Parvaresh *et al*. (2019) failed to demonstrate any significant changes in body mass index (BMI), triglycerides (TGs), low-density lipoprotein (LDL-c), high-density lipoprotein (HDL-c), and fasting insulin in the participants due to their characteristics of metabolic syndrome conditions. Only one study did not report any outcomes on the QoL of the participants following the ADF trials. This may be due to the objective of the study and different dietary assessments and the duration of the trials. Most of the reported QoL in the ADF studies showed improvement in physical activity and eating behavior.

Table 4 shows that the 5:2 diet is effective in weight loss, waist circumference, and body fat. All three studies reviewed reported positive improvement in weight management as there was a positive outcome on weight loss among participants at the end of the trials. Besides, the chosen article also highlighted that the 5:2 diet also increases the HDL-c level and TGs, while it reduces the total cholesterol (TC) after 8 weeks of trials. In terms of QoL, the 5:2 diet seems to improve the psychosocial score and emotional well-being.

Moreover, four types of IF methods were found to be able to reduce body weight, waist circumference, and fat mass. Overall, of the 21 articles reviewed, three articles (one IER study and two TRF studies) reported an absence or did not include weight loss in the finding. This is because the objectives of their study are not mainly focusing on weight loss. The remaining articles mentioned the positive effect of IF on weight loss. However, weight loss was normally only significant among obese and overweight participants. A study by Wegman *et al*. (2015) among healthy individuals showed a general lack of weight loss. This finding was supported by Ooi and Pak (2019), who stated that healthy but slightly overweight adults who underwent intervention for 3 weeks only lost 1.3 kg on average and the results obtained did not significantly differ from the baseline weight. Also, it has been mentioned that intermittent fasting is an effective strategy for the treatment of overweight and obesity (Harris *et al*., 2018). Therefore, since all types of IF are able to show positive effects on weight loss, this diet intervention is approachable for overweight or obese individuals to reduce weight. In addition, IF also has several undemanding protocols for any individual to plan their diet without interfering with their daily activity.

Moreover, some studies also mentioned the reduction in blood pressure after the IF intervention. There were five studies that reported a reduction in blood pressure after the IF intervention. This finding then was supported by Sutton *et al*. (2018) in Table 2, which detected the same finding among prediabetic men after 5 weeks of TFR intervention. During the first 3 months of ADF, the diastolic blood pressure (DBP) decreased (−5 ± 3 mmHg) and the second 3 months showed a reduction in systolic blood pressure (SBP) (−7 ± 3 mmHg) (Kalam *et al*., 2019). Parvaresh *et al*.'s study (2019), which focused on ADF, once again proved that this protocol can reduce systolic pressure (−13 ± 4.0 mmHg). IF is somewhat able to stimulate brain-derived neurotrophic factor, which is mainly produced in response to the activation of glutamatergic receptors that increase the activity of the cholinergic neurons of the cerebrospinal stem and trigger the mechanism of low blood pressure (Malinowski *et al*., 2019). Therefore, it shows that different types of IF yielded similar results in the reduction of blood pressure.

This review has also shown that three types of IF methods (IER, TRF, and ADF) reported similar results in lowering fasting blood glucose and improving insulin sensitivity or improving HOMA-IR. This finding is in line with what Grajower and Horne (2019) reported in their review paper that after a period of fasting, insulin sensitivity goes up and insulin levels go down, leading to better glucose levels both before and after a meal. The authors also highlighted that as insulin induces adipose tissue growth, there is less propensity to weight gain and potentially even weight loss. IF lowers insulin levels by reducing the frequency of eating at once, lessening insulin spikes, and reducing overall insulin levels. Reduction in insulin spikes then increases body insulin sensitivity because if the body undergoes frequent insulin spikes, it will become accustomed to insulin. As mentioned in the above paragraph, IF can reduce adiposity. This also affects insulin sensitivity, as IF can "reprogram" body metabolism.

Additionally, three types of IF methods (IER, ADF, and 5:2 diet) led to improvements in lipid profiles. The duration taken by studies that gave an impact on lipid profiles is mostly 2 months and above. Six studies from three types of IF found improvements in lipid profiles involved with limited calorie intake or alteration of calorie intake with a meal replacement. The pattern of calorie intake, duration of the trial, and focus of the study might be the reason why TRF was unable to highlight improvements in lipid profiles. Some TRF studies had a duration of less than 2 months, while one study by Moro *et al*. (2016) which had a duration of over 2 months on resistance-trained males did not involve calorie restrictions during fasting, resulting in a lack of improvement in lipid profile. Excluding the TRF study, IF can be concluded to have an improved lipid profile. IF may increase apolipoprotein A and apolipoprotein B, which can increase serum HDL-c, since apo A is a precursor of HDL (Hammouda *et al*., 2013). Other than that, IF that helps people lose weight may also help improve their lipid profiles (Santos and Macedo, 2018).

Nevertheless, IF does not have concrete evidence for improving physical activity. This review recorded some improvement in physical activity, especially in walking speed and

increasing walking steps in three types of IF methods (IER, TRF, and ADF). However, some studies from these IF categories also found no significant changes in physical activity. Current studies regarding physical performance indicators and IF also documented unclear findings, with some reporting decreased performance, while others found no significant effects (Zouhal *et al*., 2020). The articles included in this review consisted of several types of participants (obese, overweight, well-trained male, prediabetes), and the duration of each study was also different, as was the pattern for each IF. This might contribute to inconsistent findings. Different outcomes regarding physical activity parameters could be due, at least in part, to differences in how the experiments were set up, how strict the calorie restriction was, how long it lasted, and the characteristics of people who took part (Zouhal *et al*., 2020).

This shows that IF is a flexible and approachable method to improve body health and is not only applicable to achieve weight loss. Different types of IF methods may yield similar results in terms of weight loss and other nutritional health status. However, the finding regarding the QoL in terms of the physical domain is still unclear. This provides an opportunity for other researchers to study the association between IF and QoL parameters. Also, IF diets like the ones above have been studied a lot by scientists from all over the world.

CONCLUSION

In conclusion, calorie intake patterns for all four types of IF methods were different and without a fixed protocol. The pattern still can be adjusted to comply with one's daily needs or objectives of fasting. All types of IF offered similar results in terms of nutritional status. IF protocol regardless of type showed improvements in weight loss and reductions in waist circumference and fat mass, especially in overweight and obese participants. Other than that, in terms of biochemical assessment, IF protocols, regardless of type, offered similar findings. IF was able to improve lipid profile, fasting blood glucose, insulin, and blood pressure. However, to gain significant improvement in these parameters, the duration of fasting plays a crucial role. IF intervention for at least 2 months and calorie restrictions were able to show significant results.

In terms of QoL, IF showed a positive improvement in emotional well-being. Most studies that were reviewed which included the emotional well-being parameter showed improvements within 2 months. However, the four types of IF that have been reviewed showed inconsistent results in the physical activity domain for QoL. Some studies have shown that IF is able to improve physical activity, and some showed the opposite or no changes at all. Different geographical areas that influence the climate and later the physical activity domain might contribute to inconsistent outcomes. In conclusion, different types of IF showed similar results in terms of nutritional status and certain aspects of QoL. IF, regardless of the type, is able to improve anthropometry parameters such as weight, waist circumference, and body fat. It also showed promising results in cardiometabolic parameters and emotional well-being.

AUTHOR CONTRIBUTIONS

All authors made substantial contributions to the conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work. All the authors are eligible to be an author as per the international committee of medical journal editors (ICMJE) requirements/ guidelines.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

ETHICAL APPROVALS

Ethical approval was obtained from Universiti Malaysia Terengganu: UMT/JKEPM/2022/96.

DATA AVAILABILITY

All data generated and analyzed are included in this research article.

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