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Review Article

The Effect of Intermittent Fasting Combined with Ad Libitum Days on Adults' Elevated Blood Pressure: A Systematic Review of Human Studies

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Abstract

Background: Diets utilizing intermittent fasting as an alternative method to promote weight loss have grown in popularity. However, the efficacy of intermittent among elevated blood pressure remains unclear. This review systematically analyses studies investigating the effects of intermittent variations among elevated blood pressure on changes in systolic blood pressure and diastolic blood pressure. Changes in body weight, body mass index, waist circumference, and energy intake were assessed as a secondary objective.

Methods: The American Search Elite, CINAHL, Cochrane, MEDLINE, ProQuest, PubMed, Scopus, and grey literature databases were searched for articles investigating intermittent fasting with ad libitum among adults with elevated blood pressure from Jan 2010 to Jun 2022.

Results: Twelve studies met the eligibility criteria. Systolic and diastolic blood pressure generally decreased, between -2.0 to -0.04 mmHg and -3 to -0.01 mmHg, respectively. The body weight and body mass index reduced significantly (-2.85 to -0.09 kg and -1.05 to -0.03 kg/m², respectively). The review found a waist circumference reduction of -0.67 to -0.21 cm and an energy intake reduction of -263.89 to -2.58 kcal.

Conclusion: Intermittent fasting reduces systolic and diastolic blood pressure in 2-24 wk while decreasing body weight, body mass index, and energy intake. However, needs 48 wk to reduce waist circumference. This implies that it is critical to perform intermittent fasting on elevated blood pressure before the development of high blood pressure as part of a program to prevent hypertension in adults.

Keywords: Intermittent fasting; Blood pressure; Weight loss; Body mass index; Waist circumference; Adult

Introduction

Uncontrolled hypertension will increase the risk of other diseases with adverse effects, including coronary heart disease, stroke, congestive heart failure, renal insufficiency, and peripheral vascular disease, which are significant causes of mor-

bidity and mortality (1, 2). Moreover, untreated high blood pressure (BP) can lead to heart attack, stroke, blindness, and kidney disease (3, 4). If the elevated BP, which is the first stage of high BP, is ignored, there is a higher likelihood of it resulting in stage 1 and over and will increase the cost of hypertension treatment (5, 6). The European Society Control Guideline 2018 sets EBP as high normal with a range of 130-139/85-89 mm (7, 8).
Many non-pharmacological interventions have been conducted to reduce the prevalence of hypertension among adults, such as weight reduction, sodium intake reduction, alcohol reduction, increased regular physical activity, healthy eating, and smoking cessation (9, 10). However, the interventions that addressed elevated BP intervention were limited (11-13). Elevated BP was positively associated with the prevalence of coronary artery calcium, structural heart disease, and increased cardiovascular disease risk compared with normotensive (11-14). Therefore, it is required appropriate interventions among adults to reduce the prevalence of elevated BP and reverse them to normotensive.
Intermittent fasting is a lifestyle intervention to reduce weight, especially among obese and diabetic patients. The significant outcomes of intermittent fasting include weight reduction, control of blood glucose level, and reduction of BP among obese and diabetic patients (15-18). However, little is known about the effectiveness of intermittent fasting among people with elevated BP. Several different types and methods of intermittent fasting have emerged, such as alternate day fasting (ADF) (15, 17, 19-22), the 2:5 diet: two fasting days followed by five feast days (23, 24), the eat-stop-eat: a 24 hour fast (25) and religious fasting (26).
To date, the aforementioned approaches have not been reviewed systematically on the elevated BP participants. Therefore, this systematic review assessed the effectiveness of intermittent fasting in various types of intervention studies and observational studies in reducing systolic BP and diastolic BP among elevated BP participants. The secondary objectives were to assess the effects of the same method protocols on body weight, body mass index (BMI), waist circumference, and energy intake.

Materials and Methods

Literature search and study selection

The databases used in this study were American Search Elite, CINAHL, Cochrane, MEDLINE, ProQuest, PubMed, and Scopus. This study focused on intermittent fasting intervention studies that targeted elevated BP participants where systolic and diastolic BP were the primary outcomes. This review was conducted and reported according to the PICOS (Participants, Intervention, Comparison, Outcomes, and Study Design) criteria in identifying the appropriate studies (17, 27). This study also adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (28).
The inclusion criteria of this study were; 1) the study used the English language, 2) humans as subject, 3) adults with raised BP either elevated BP, stage one and stage two, 4) the abstract explicitly addressed intermittent fasting, 5) fasting conducted over a maximum of 5 d/week up to 6 months duration with ad libitum days, and 6) the study was conducted between Jan 2010 to Jun 2022. The papers were excluded if; 1) the study was conducted in health services or health care, 2) the study was conducted based on specific diseases, and 3) fasting at night.
Searching strategies began with the title and abstract analysis using specific keywords related to intermittent fasting and elevated BP from the published articles; intermittent fasting (fasting, intermittent fasting, alternate day fasting, calorie restriction, energy restriction, early time-restricted feeding), adult (adult, adulthood, middle age), elevated blood pressure (blood pressure, elevated blood pressure, high blood pressure, raised blood pressure), body mass index (body mass index, body density), body weight (body weight, body composition, body size, weight loss, weight gain), waist circumference (waist circumference, waistline, abdomen circumference, hip circumference),

energy intake (calorie reduction, calorie intake, energy intake, food intake).

The study has been registered to PROSPERO (The International Prospective Register of Systematic Reviews) with registration number: CRD42021235304.

Data extraction and assessment risk of bias

One of three reviewers extracted relevant information from the articles to EndNote version 9.2, Thomson Reuters, Philadelphia, USA. Two authors screened and reviewed the titles and selected abstracts based on eligibility criteria. Outcomes that will be considered primary measures and outcome effects include decrement, increment, significant changing/s, and significant difference/s. The Cochrane Collaboration tool (ROB2 and ROBINS I) was used to assess the risk of bias in randomized and non-randomized control trials (29). At the same time, the Eight-Star Newcastle-Ottawa Scale (NOS) for cohort and case-control studies was used to assess the risk of bias in observational studies (30).

Results

The search was performed on 27 Feb 2021 and 6008 articles were identified. This was followed by duplicate, title, and abstract screening, 10 were determined. An update search was conducted on 29 Jul 2022, resulting in 971 articles and 1263 articles were retrieved from the references and a grey literature search. Only 2 additional articles were included in the final analysis (total of 12 articles with 1007 respondents). Although there were seven articles on RCT, it was unnecessary to conduct the meta-analysis, as the interventions (the amount of energy restriction and number of fasting days) were different from each other. This study also did not analyse the publication bias as the design heterogeneity. Therefore, because of those differences, this study adopted a narrative approach to synthesize the results (31) (Fig. 1).

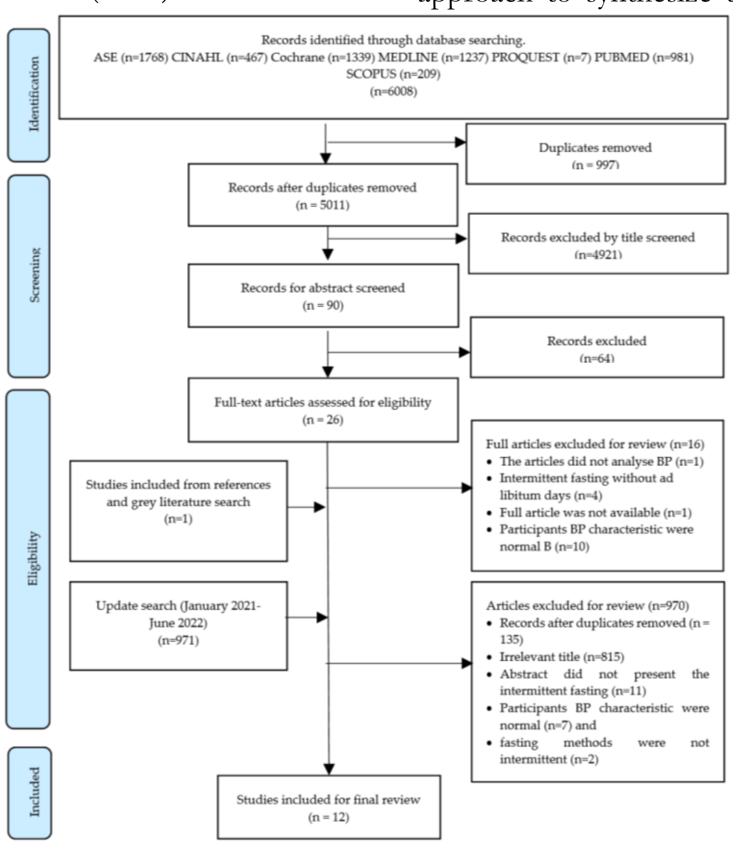

Fig. 1: PRISMA diagram for the systematic review workflow

Quality appraisal

Six of the seven randomized controlled trial (RCT) studies that used ROB2 tools were of high quality (19, 21, 32-35) and one was fair (36). Three cohort studies could be regarded as high-quality (37-39). The sole cross-sectional study was of high quality and used NOS (40), while the interventional non-RCT studies used ROBINS I and were of fair quality (41). The supplementary Figs. 2, 3, 4 appraise the quality of the studies.

	V1	V2	V3	V4	V5	V6	V7	Quality
Jospe et al., 2020	+	+	+	+	+	+	+	☆
Parvaresh et al., 2019	+	+	+	+	+	+	+	☆
Gabel et al., 2019	+	+	+	+	−	+	+	−
Bowen et al., 2018	+	+	+	+	+	+	+	☆
Conley et al., 2018	+	+	+	+	+	+	+	☆
Trepanowski et al., 2017	+	+	+	+	+	+	+	☆
Teng et al., 2013	+	+	+	+	+	+	+	☆

+ Low risk, − Unclear risk, ☆ Good Quality, − Fair Quality

Fig. 2: Quality appraisal on randomized control trial, Domains: V1: Selection bias of random sequence generation, V2: Selection bias of allocation concealment, V3: Performance bias of blinding participants and personnel, V4: Detection bias of blinding outcomes, V5: Attribution bias of incomplete outcome data, V6: Reporting bias of selective, V7: Other sources of bias

	V1	V2	V3	V4	V5	V6	V7	Quality
Kessler et al., 2018	+	+	+	−	+	+	+	−

+ Low risk, − Unclear risk, ☆ Good Quality, − Fair Quality

Fig. 3: Quality appraisal on interventional study, Domains: V1: Bias due to confounding, V2: Bias in selection of participants into the study, V3: Bias in classification of interventions, V4: Bias due to deviations from intended intervention, V5: Bias due to missing data, V6: Bias in measurement of outcomes, V7: Bias in selection of the reported result

	V1	V2	V3	Quality
Widhalm et al., 2017	+	+	+	☆
Li et al., 2013	+	+	+	☆
O'Driscoll et al., 2021	+	+	+	☆
Lin et al. 2021	+	+	+	☆

+ Low risk, − Unclear risk, ☆ Good Quality, − Fair Quality

Fig. 4: Quality appraisal on non-randomized control trial, Domains: V1: Selection Bias, V2: Comparability, V3: Outcome

Respondent characteristics

The participant's age was 18 to 73 yr old, with a BMI of 23.0-39.9 kg/m^2. All the studies involved participants with elevated BP and only one study did not provide the diastolic BP measurement (37). Only one study was conducted in a Lower-Middle Income Country (35), while others were executed in the Upper-Middle Income Countries (19, 21, 32-34, 36-41). Most studies relied on self-reported which used food records to analyse the nutrition intake (21, 34-36), while only one study used weighed diet records (32). Two studies did not require calorie restriction during the fasting days (37, 39) and whole studies did not require calorie restriction in the non-fasting days. Table 1 presents detailed information on the twelve studies.

Table 1: The characteristics of studies included in the final analysis (n=12)

Author (year)/ Study setting	Participants details					Intervention details			
	Number at baseline to (*) end line	**Age range**	**BMI range**	**Design IF type**	**Study duration # fasting days**	**Statistical analyses/ adjusted variable**	**Estimated calorie reduction in the fasting day**	**Fast and feast day regimen**	**Assessment of dietary intake**
Lin et al., 2021 (40) **Chicago, United State**	IG 75*75	18-65 yr	25.0-39.9 kg/m^2	Cross-sectional ADF	12 wk 36 d	ANOVA and repeated ANOVA test	Only consumed 400-500 kcal/day of calorie	Fast day: 30%-35% fat, 30%-55% carbohydrate, and 15%-35% protein. Consumed calorie-free beverages Feast day: consumed food ad libitum	Self-report
O'Driscoll et al., 2021 (39)	IG 94*36	18+ yr	≥29 kg/m^2	Cohort ADF	48 wk 96 d	No statistical test information available	NA	Fast day: NA Feast day: NA	Self-report
Jospe et al., 2020 (32)	IG 136*99 AG 68*47 AG 46*25	≥18 yr	≥27 kg/m^2	RCT ADF Paleo Mediterranean	48 wk 48 d	Mixed-effects regression models, adjusted[a]	Restrict the daily calorie intake to 500-600 kcal/day	Fast day: no provided meal Feast day: consumed food ad libitum	Weighed diet records
Parvaresh et al., 2019 (33)	IG 35*35 AG 35*34	25-60 yr	25 ≤BMI ≤ 40 kg/m^2	RCT ADF CR	10 wk 24 d	Pair t-test and ANCOVA test, adjusted[b]	Consumed 25% of energy requirement as a lunch (between 12-2 pm)	Fast day: no provided meal consumed calorie-free beverages Feast day: consumed 100% of energy requirement on 3 feed days, and ad-libitum on Friday	NA
Gabel et al., 2019 (36)	IG 34*11 AG 35*17 CG 31*15	18-65 yr	25.0-39.9 kg/m^2	RCT ADF CR Control	48 wk 75 d	ANCOVA test, unadjusted	Reduce 25% of energy intake/day	Fast day: the meals were provided during first 3 months. 30% energy as fat, 55% as carbohydrate, and 15% as protein. Feast day: 125% of baseline energy needs on 3 feed days.	7-day food record
Bowen et al., 2018 (21)	IG 82*67 CG 81*68	25-60 yr	>27.0 kg/m^2	RCT Periodic-IF+DER DER	24 wk 48 d	Linear mixed-effects model, unadjusted	Energy deficit about 700 kJ/day	Fast day: reduced 40% carbohydrate, 34% protein, 22% fat Feast day: reduced 31% carbohydrate, 38% protein & 28% fat	Self-report

Table 1: Continued …

Conley et al., 2018 (34)	IG 12*11 AG 12*12	55-75 yr	≥ 30.0 kg/m²	RCT ADF SERD	24 wk 24 d	Wilcoxon signed-rank test, two sample Wilcoxon rank-sum & linear regression test, unadjusted	Restrict the daily calorie intake to 600 kcal/day	Fast day: no provided meal consumed calorie-free beverages Feast day: consumed food ad libitum	self-report
Kessler et al., 2018 (41)	IG 22*20 CG 14*13	18-65 yr	20.0–25 kg/m²	Quasi ADF Control	8 wk 8 d	Wilcoxon signed-rank test, Wilcoxon rank sum, per-protocol analysis, unadjusted	Only consumed 300 kcal/day of calorie	Fast day: no provided meal consumed calorie-free beverages Feast day: consumed food ad libitum	NA
Widhalm et al., 2017 (37)	IG 9*9	18-48 yr	>27 kg/m²	Cohort ADF	12 wk 60 d	Per-protocol analysis	NA	Fast day: no provided meal consumed Feast day: consumed food ad libitum	NA
Trepanowski et al., 2017 (19)	IG 34*21 AG 35*25 CG 31*23	18-65 yr	25.0-39.9 kg/m²	RCT ADF DCR Control	48 wk 84 d	ITT and mixed linear model.	Restrict the daily calorie intake to 25% of energy requirement as a lunch (between 12-2 pm)	Fast day: provided meal; 30% fat, 55% carbohydrate, and 15% protein Feast day: Consumed 125% of energy requirement between 3 meals	NA
Teng et al., 2013 (35)	IG 28*28 CG 28*28	50-70 yr	23.0–29.9 kg/m²	RCT ADF Control	12 wk 24 d	Repeated measures ANOVA, adjusted[c]	Restrict the daily calorie intake to 300-500 kcal/day	Fast day: no provided meal Fasting for 13 h Feast day: consumed food ad libitum	self-report
Li et al., 2013 (38)	IG 30*28	40-73 yr	≥23 kg/m²	Cohort Periodic-IF	2 wk 7 d	Wilcoxon signed-rank test, unadjusted	Only consumed 300 kcal/day of calorie	Fast day: provided meal; 200 cl fruit juice, and vegetable soup (300 kcal) consumed calorie-free beverages Feast day: calorie consumed was 1800 kcal/day	NA

[a]adjusted for age, sex, exercise group, randomized support group, physical activity (counts per minute), and baseline. [b]adjusted for age, sex, energy and BMI. [c]adjusted for health status and smoking. ANCOVA: analysis of covariance, ITT: intention-to-treat analysis, IG: intervention group, AG: active group, CG: control group, CR: calorie restriction, DER: daily energy restriction, SERD: standard energy restricted-diet, DCR: daily calorie restriction, NA: not applicable, BMI: body mass index, Kcal: kilo calories

The final analysis showed an average reduction in systolic BP in twelve articles from -2.04 to -0.06 mm Hg (19, 21, 32-41). Eleven studies showed a reduction in diastolic BP ranging from -3 to -0.01 mm Hg (19, 21, 32-36, 38-41). Twelve papers also analyzed weight loss ranging from -2.85 to -0.09 kg (19, 21, 32-41). Nine papers measured BMI with a mean reduction ranging from -1.05 to -0.03 kg/m² (21, 33-36, 38-41). Only four studies measured waist circumference reduction which ranged from -0.67 to -0.21 cm (33, 34, 39, 41) and five studies measured the total energy amount with the mean reduction ranging from -263.89 to -2.58 kcal (32, 34-36, 40) (Table 2).

Table 2: Outcomes of risk factors for elevated blood pressure in twelve studies enrolling adults

Risk factors	Outcome	N	Studies (Weekly average changes)	Significances
Systolic blood pressure	↓	1007	Examined in 12 studies, with a decrease in the intervention phase; *Lin et al.: -0.25 mm Hg (40), *O'Driscoll et al.: -0.06 mm Hg (39), Jospe et al.: -0.04 mm Hg (32), Parvaresh et al.: -1.3 mm Hg (33), *Gabel et al.: -0.38 mm Hg (36), *Bowen et al.: -0.3 mm Hg (21), *Conley et al.: -0.53 mm Hg (34), Kessler et al.: -0.19 mm Hg (41), *Widhalm et al.: -1.21 mm Hg (37), Trepanowski et al.: -0.13 mm Hg (19), *Teng et al.: -0.32 mm Hg (35), and Li et al.: -8.1 mm Hg (38). Then a decrease in the maintenance phase; Jospe et al.: -0.41 mm Hg (32), Gabel et al.: -0.38 mm Hg (36), *Conley et al.: -1.16 mm Hg (34), *Widhalm et al.: -2.04 mm Hg (37), Trepanowski et al.: -0.19 mm Hg (19), and *Teng et al.: -0.77 mm Hg (35).	7 studies examined significant changes; Lin et al. (40), Jospe et al. (32), Parvaresh et al. (33), Bowen et al. (21), Conley et al. (34), Widhalm et al. (37), and Li et al. (38). 2 studies examined significant differences after intervention; Parvaresh et al.(33) and Teng et al.(35).
Diastolic blood pressure	↓ ↑	942 56	Examined in 10 studied, with a decrease in the intervention phase; *Lin et al.: -0.25 mm Hg (40), *O'Driscoll et al.: -0.02 mm Hg (39), Jospe et al.: -0.07 mm Hg (32), Parvaresh et al.: -0.8 mm Hg (33), *Gabel et al.: -0.42 mm Hg (36), *Bowen et al.: -0.17 mm Hg (21), *Conley et al.: -0.37 mm Hg (34), Kessler et al.: -0.68 mm Hg (41), Trepanowski et al.: -0.06 mm Hg (19), and Li et al.: -3 mm Hg (38). Then a decrease in the maintenance phase; Jospe et al.: -0.24 mm Hg (32), Gabel et al.: -0.21 mm Hg (36), *Conley et al.: -0.02 mm Hg (34),Trepanowski et al.: -0.01 mm Hg (19), and *Teng et al.: -0.62 mm Hg (35). Examined in 1 study, with an increase in intervention phase; *Teng et al.: +0.25 mm Hg (35).	6 studies examined significant changes; Lin et al. (40), Jospe et al. (32), Parvaresh et al. (33), Bowen et al. (21), Kessler et al. (41), and Li et al. (38). 1 study examined significant difference after intervention; Teng et al. (35).
Body weight	↓	1007	Examined in 12 studies, with a decrease in intervention phase; *Lin et al.: -0.42 kg (40), *O'Driscoll et al.: -0.17 kg (39), Jospe et al.: -0.18 kg (32), Parvaresh et al.: -0.41 kg (33), *Gabel et al.: -0.38 kg (36), Bowen et al.: -0.45 kg (21), *Conley et al.: -0.38 kg (34), Kessler et al.: -0.09 kg (41), Widhalm et al.: -0.38 kg (37), Trepanowski et al.: -0.28 kg (19), *Teng et al.: -0.33 kg (35), and Li et al.: -2.85 kg (38). Then a decrease in the maintenance phase; Jospe et al.: -0.17 kg (32), Gabel et al.: -0.33 kg (36), Conley et al.: -0.44 kg (34), Widhalm et al.: -0.59 kg (37), Trepanowski et al.: -0.25 kg (19), and *Teng et al.: -0.42 kg (35)	8 studies examined significant changes; Lin et al. (40), O'Driscoll et al. (39), Jospe et al. (32), Parvaresh et al. (33), Bowen et al. (21), Conley et al. (34), Widhalm et al. (37), and Li et al. (38). 2 studies examined significant differences after intervention; Parvaresh et al. (33) and Jospe et al. (32) 2 studies examined significant differences after maintenance: Gabel et al. (36) and Teng et al. (35)
Body mass index	↓	648	Examined in 9 studies, with a decrease in intervention phase; *Lin et al.: -0.08 kg/m^2 (40), *O'Driscoll et al.: -0.06 kg/m^2 (39), Parvaresh et al.: -0.16 kg/m^2 (33), *Gabel et al.: -0.04 kg/m^2 (36), *Bowen et al.: -0.23 kg/m^2 (21), *Conley et al.: -0.13 kg/m^2 (34), Kessler et al.: -0.03 kg/m^2 (41), *Teng et al.: -0.08 kg/m^2 (35), and Li et al.: -1.05 kg/m^2 (38). Then a decrease in the maintenance phase; Gabel et al.: -0.08 kg/m^2 (36), *Conley et al.: -0.16 kg/m^2 (34), and *Teng et al.: -0.15 kg/m^2 (35).	6 studies examined significant changes; Lin et al. (40), O'Driscoll et al. (39), Parvaresh et al. (33), Bowen et al. (21), Conley et al. (34), and Li et al. (38). 1 study examined significant difference after intervention; Conley et al. (34). 1 study examined significant difference after maintenance; Teng et al. (35).
Waist circumference	↓ ↑	188 36	Examined in 3 studies, with a decrease in intervention phase; *O'Driscoll et al.: -0.21 cm (39), Parvaresh et al.: -0.4 cm (33), and *Conley et al.: -0.49 cm (34). Then a decrease in the maintenance phase; *Conley et al.: -0.67 cm (34). Examined in 1 study, with an increase in intervention phase; Kessler et al.: +0.04 cm (41).	2 studies examined significant changes; Parvaresh et al. (33) and Conley et al. (34). 1 study examined significant difference after intervention; Parvaresh et al. (33).
Energy intake	↓ ↑	505 180	Examined in 5 studies, with a decrease in intervention phase; *Lin et al.: -76,17 kcal (40), *Jospe et al.: -24.04 kcal (32), *Gabel et al.: -21.5 kcal (36), *Conley et al.: -263.89 kcal (34), *Teng et al.: -54.5 kcal (35). Then a decrease in the maintenance phase; *Jospe et al.: -2.58 kcal (32). Examined in 3 study, with an increase in maintenance phase; *Gabel et al.: +84.13 kcal (36), *Conley et al.: +32.27 kcal (34), and *Teng et al.: +3.67 kcal (35)	2 studies examined significant changes; Lin et al. (40) and Conley et al. (34). 2 studies examined significant differences after maintenance; Jospe et al. (32) and Teng et al. (35).

N: sample, ↓: decrease, ↑: increase**, *:** Mean change was calculated as difference of means from baseline to follow-up from data of the publication

Discussion

To our knowledge, this is the first study to provide a comprehensive overview of the effectiveness of intermittent fasting among elevated BP adults. Intermittent fasting programs with ad libitum days impair gains in systolic and diastolic BP compared to control and other diet methods. The mean change of systolic and diastolic BP varied perhaps due to the different BP statuses in the baseline, the amount of calorie restriction, and the length of study duration (42). Furthermore, where old age is easier to experience elevated BP compared to young age, as physiological changes to the carotid-femoral pulse wave velocity will increase gradually as age increases (43). However, unfortunately, this review is unable to describe intermittent fasting effectiveness based on age. Overall, all investigations showed that interventions reduced adults' BP optimally in 2-24 wk, while continuing intermittent fasting for up to 48 wk contributed to stabilizing the BP.

Furthermore, most studies showed a reduction in body weight, BMI, and energy intake during the same period (2-24 wk). In contrast to all outcomes, the highest reduction of waist circumference was found in 48 wk. It might be due to bad eating patterns such as excessive snack consumption or large meals late at night which could increase the waist circumference (44, 45). A longer intervention time with the combination of calorie restriction was required to reduce waist circumference (46). Moreover, another study also suggested implementing intermittent fasting with high-intensity interval training rather than fasting alone (47).

Basically, during the intermittent fasting diet, the participants will reduce their energy through fasting, decreasing weekly calorie and energy intake which has implications for a reduction of body weight, BMI, and waist circumference (17). However, this would exist if the participants consistently maintained their daily energy consumption. Energy imbalance has been identified as a significant contributor to the etiology of obesity. A fluctuation in body weight and critical obesity plays essential roles in developing metabolic disorders. These factors will increase visceral adiposity and lean body mass which are significant determinants of BP increase (48). For adults, weight loss and weight maintenance programs through energy restriction and increased physical activity are essential to reduce high BP (49).

Several biochemical and cellular changes associated with intermittent fasting may account for an increase in weight loss. However, it is understood that it is not as simple as energy in versus energy out. It may involve many complex factors, including genetics, environmental, socioeconomic, and psychological (50). As people age, several factors contribute to changes in metabolism, leading to a generally slower metabolic rate that causes obesity and leading to elevated BP (43), which also needs to be considered. During fasting, participants' metabolism is anticipated to shift from lipolysis to ketogenesis (51). Intermittent fasting causes a metabolic switch in which fuel utilization and food partitioning shift from glucose to fat oxidation (52). Therefore, intermittent fasting can be a promising alternative strategy for reducing body weight, BMI, and waist circumference. Hence, these changes will support the reduction of systolic and diastolic BP.

The several limitations of this study were: 1) the energy calculation came from reported energy intake. This could be a bias of the energy intake among participants, 2) all the papers retrieved were from high-income countries context, and 3) the selected paper did not provide the duration of intermittent fasting and its effectiveness based on age categories, which makes the effectiveness of this intervention at different ages not visible.

Conclusion

The current systematic review has shown the impact of intermittent fasting on systolic BP, diastolic BP, body weight, BMI, waist circumference, and energy intake clearly. The intermittent fasting intervention is more beneficial in reducing the outcomes for 24 wk, while more than 24 wk will maintain a healthy body. Fasting for the whole year is not recommended as it does not give scientific evidence of its effectiveness. The other health outcomes effects of different intermittent fasting types among elevated BP participants should be examined in future research.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Data availability

No supplementary materials in this paper were published. Please contact the authors for data access.

Conflict of interest

The authors declare that there is no conflict of interests.

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