Hindawi
Journal of Food Biochemistry
Volume 2023, Article ID 6655305, 11 pages
https://doi.org/10.1155/2023/6655305

WILEY | Hindawi

Review Article

The Effects of Purslane Consumption on Obesity Indices: A GRADE-Assessed Systematic Review and Meta-Analysis of Randomized Controlled Trials

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Received 15 June 2023; Revised 2 October 2023; Accepted 16 October 2023; Published 23 October 2023

Academic Editor: Walid Elfalleh

Obesity and overweight are among the most significant global health challenges that affect both developed and developing countries, leading to various chronic diseases. Previous studies have reported inconsistent results regarding the effects of purslane supplementation on obesity indices. Therefore, the aim of this study was to perform a meta-analysis on the effects of supplementation with purslane on obesity indices among adults. Comprehensive systematic searches were performed throughout Web of Science, EMBASE, PubMed, Scopus, and Cochrane Library databases up to May 30, 2023. All randomized controlled trials (RCTs) that investigated the impact of purslane supplementation on obesity indices were included into the analysis. The I^2 and Cochran's Q tests were used to assess heterogeneity between studies. The effect sizes were reported as the weighted mean difference (WMD) and 95% confidence intervals (CIs) using a random effects model. The initial search yielded 789 studies, of which seven RCTs were included in analysis. Following purslane supplementation, body weight (BW) (WMD: −0.94 kg, 95% CI: −1.57–−0.31, and $P = 0.002$) and body mass index (BMI) (WMD: −0.53 kg/m^2, 95% CI: −0.88–−0.18, and P: 0.001) decreased significantly. However, this meta-analysis could not show any beneficial effect of purslane supplementation on waist circumference (WC) (WMD: −0.28 cm, 95% CI: −1.47–0.91, and $P = 0.23$). In addition, there was no linear association between the duration of treatment and sample size with BW, BMI, and WC. In conclusion, this meta-analysis showed a significant effect of purslane supplementation on BMI and BW but not on WC in adults, suggesting that it has the potential to be used therapeutically. Moreover, the combined results of previous RCTs indicate that purslane is a safe and effective intervention for reducing obesity indices in subjects with metabolic syndrome or obesity. As such, the consumption of purslane may have indirectly contributed to the amelioration of clinical symptoms in diseases with metabolic disorders, owing to its impact on some obesity indices. However, given the limitations and the low number of included studies in the present meta-analysis, more large-scale RCTs are needed to shed light on this issue.

1. Introduction

Obesity is a preventable threat to human health, characterized by excessive fat accumulation in the adipose tissue, caused by an unequal balance between energy expenditure and intake [1, 2]. According to the latest report published by the World Health Organization (WHO) in 2016, 39% of the global adult population (≥18 years) were overweight, while 13% were classified as obese [3]. Meanwhile, the obesity epidemic is rapidly spreading across the Asia-Pacific region. The prevalence of obesity in West Asia and East Asia reached 11.9% and 24.5%, respectively [4]. Specifically, obesity and overweight are serious public health issues in Iran, affecting a large proportion of the adult population. Recent estimates suggest that 22.7% of the adults are obese and 59.3% are overweight [5]. Various comorbidities are associated with obesity, such as hyperlipidemia, metabolic syndrome (MetS), coronary heart disease, cancer, hypertension, mental disorders, and diabetes [6]. Inflammatory states induced by excess body fat may contribute to obesity's association with these diseases. Despite some attempts to prevent and control obesity and its complications, these strategies are challenging to implement correctly and have had limited success over time [7]. Currently, lifestyle modification and pharmacological or herbal interventions [8–10] are being used for treating obesity, which focuses on reducing appetite and increasing the basal metabolic rate [11, 12]. Herbal supplements have become increasingly popular due to their fewer adverse effects and lower cost compared to manufactured medications [13, 14].

Purslane, a member of the Portulacaceae family, is one of the most widely used medicinal plants [15]. It has been traditionally used to treat many diseases due to its anti-inflammatory and antioxidant properties [16] and its active biologic compounds that are beneficial to human health [17]. Purslane's most active compounds include omega-3, tocopherol, carotene, amino acids, thiamine, ascorbic acid, niacin, and phenolic compounds such as quercetin, kaempferol, caffeic acid, ferulic acid, and p-coumaric acid [18]. Purslane has the highest concentration of omega-3 fatty acids, particularly alpha-linolenic acid, when compared to other leafy green vegetables [19]. This makes it an elixir or panacea used for various therapeutic purposes [20]. Several studies have reported that purslane seeds or purslane extract may have antiobesity properties [21–23].

The compounds niacin and thiamine present in purslane may be responsible for its effectiveness in weight reduction. This is because they act as coenzymes in the conversion of carbohydrates, fats, and proteins into usable energy [21]. The anti-obesity properties of purslane may also be exerted by its effect on insulin [21]. However, the precise effects of purslane on anthropometric indices remain unclear. To our knowledge, there is no systematic review or meta-analysis of randomized controlled trials (RCTs) that evaluated purslane's effect on obesity indices. Therefore, this study aimed to determine whether purslane supplementation affected body weight (BW), body mass index (BMI), and waist circumference (WC) among adults.

2. Methods

This meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Supplementary Table 1) [24]. The protocol of the current study has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) system under the registration number CRD42023426343. The present systematic review and meta-analysis protocol has been approved by the Ethics Committee of Isfahan University of Medical Sciences (approval number: IR.MUI.RESEARCH.REC.1402.108 and grant number: 140275).

2.1. Search Strategy. To identify relevant papers from inception until May 2023, various electronic databases including Web of Science, EMBASE, PubMed, Scopus, and Cochrane Library databases were searched. The following MESH and non-MESH words were used: ("Portulaca" OR "Purslane" OR "Portulaca oleracea") AND ("waist circumference" OR "weight loss" OR "BMI" OR "obesity" OR "Overweight" OR "weight" OR "Body Mass Index" OR "adipose tissue" OR "fat mass" OR "WC" OR "adiposity" OR "WHR" OR "waist-to-hip ratio"). There were no language restrictions. Other relevant publications were also identified by reviewing the reference lists of the included studies. In order to obtain the full text for those articles that met inclusion criteria but were not available in full text, their authors were contacted via email.

2.2. Study Selection. The inclusion criteria for the studies were as follows: (1) crossover or parallel-design controlled clinical trials, (2) involving individuals aged 18 years and older, (3) reporting at least one of the following variables: BW, BMI, and WC in both treatment and placebo groups before and after the intervention, and (4) reporting mean and standard deviation (SD) values of one of the following measures: BW, BMI, and WC. For datasets containing multiple publications, only the complete study was included. However, several studies were excluded because they did not meet the inclusion criteria. Specifically, studies were excluded if they (1) did not have a placebo or control group, (2) did not have adequate outcomes data in either intervention or control groups, (3) were patents or dissertations, (4) involved children, pregnant women, or animals, and (5) evaluated the combined effect of purslane with other interventions such as obesity drugs (antidepressant, corticosteroid, and so on).

2.3. Data Extraction. Two investigators (SH and MV) independently extracted data from eligible studies, and the principal investigator (MB) determined whether there was disagreement to reach an agreement. The following information was collected: the first author's name, the study design, the publication year, the duration of the trial, the study location, the dose of purslane, the intervention form, the health status of the participants, their mean ages, their sexes, the sample size for the control and intervention groups, and the mean changes and SD of anthropometric measures for the control and intervention groups.

2.4. Study Quality and Certainty of the Evidence. The quality assessments of included studies were conducted by two authors (SH and MV) using the Cochrane risk-of-bias tool. The tool includes the following seven domains: random sequence generation, blinding of personnel and participants, allocation concealment, blinding of outcomes, selective reporting, incomplete outcome data, and other biases. Studies were categorized as high quality if at least three domains showed low bias potential [25]. The overall certainty of evidence in the studies was graded using guidelines developed by the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) working group. Based on relevant evaluation criteria, evidence quality was categorized into four levels as follows: high, medium, low, and very low.

2.5. Statistical Analysis. Stata statistical software version 14 (StataCorp, College Station, TX, USA) was used to conduct all analyses. The overall estimates for the intervention and control groups were calculated based on the mean and SD of BW, WC, and BMI. To calculate effect sizes for all variables, weighted mean differences (WMDs) were applied along with 95% confidence intervals (CIs) [26]. Cochran's Q test was quantified using the inconsistency index (I-squared) to assess heterogeneity between studies [25]. Studies with high heterogeneity were identified by $I^2 \geq 50\%$ and P value of Q statistic <0.1 [27]. Subgroup analyses have been performed to investigate possible sources of heterogeneity. A sensitivity analysis was performed to examine the influence of any single study or group of studies on the results [28]. Publication bias was assessed using funnel plots and Begg's and Egger's tests [28]. In addition, a metaregression analysis was performed to examine the relationship between the estimated effect size and the trial duration and sample size.

3. Results

3.1. Results of the Search. A total number of 789 articles were identified at the end of the primary search of databases. The title and abstract of each record were screened after removing 130 duplicates, resulting in the selection of 26 studies for further assessment. In the next step, 19 studies were excluded based on the full-text review. These eliminations were due to the following reasons: administered purslane in combination with other components ($n = 6$), those without a placebo group ($n = 5$), and trials that did not provide sufficient data for outcomes ($n = 8$). Finally, seven studies were included in this systematic review and meta-analysis [17, 22, 23, 29–32]. The flow diagram of the literature search process is shown in Figure 1.

3.2. Study Characteristics. The total number of detected trials according to the type of variables was as follows: seven studies for BW, seven studies for BMI, and five studies for WC. The important characteristics of the seven included trials are summarized in Table 1. These trials were published from 2007 to 2018 and conducted in Iran [17, 22, 23, 29, 30, 32] and Israel [31]. The sample size in the included studies ranged from 20 to 71. Daily dosage of purslane varied between 180 and 10,000 mg, and duration of purslane supplementation varied from 8 to 12 weeks. In total, 374 participants were enrolled in these trials, of which 220 individuals were allocated to the purslane supplementation group and 226 subjects to the control group. The mean age of the participants ranged from 22.1 to 58.3 years old, and the mean baseline BMI varied from 26.30 to 32.70 kg/m^2. The study participants included patients with MetS [23], type 2 diabetes (T2DM) [17, 31], asthma [32], nonalcoholic fatty liver disease (NAFLD) [22, 29], and obese or overweight women [30]. All trials were conducted on both genders except for two studies that were done exclusively on women [23, 30]. Regarding changes in BW, three studies [17, 22, 23] reported a significant reduction, while four studies did not find such an effect. According to the current systematic review, three studies reported a decrease in BMI with purslane [17, 22, 30], while three studies failed to find any significant effect on BMI. Few trials evaluated the effect of purslane on WC. Based on their results, two trials reported a favorable effect of purslane intake on WC reduction [22, 23], while others found no significant effect.

3.3. Risk-of-Bias Assessment and GRADE Assessment. The results of the quality assessment of the included trials are available in Figure 2. The GRADE profile for the certainty of the evidence is included in Supplementary Table 2. The moderate quality of BW and BMI was due to serious limitations in indirectness. In addition, WC was considered low quality due to serious limitations in imprecision and indirectness.

3.4. Meta-Analysis

3.4.1. The Effects of Purslane Supplementation on BW. Seven eligible studies, with a total of 379 participants, investigated the effect of purslane supplementation on BW. BW significantly decreased in the purslane group showed a significant decrease in BW compared to the control group (WMD: −0.94 kg, 95% CI: −1.57–−0.31, and $P = 0.002$), with significant heterogeneity among the trials ($I^2 = 68.9\%$ and $P = 0.004$) (Figure 3). Subgroup analyses revealed a more pronounced reduction in BW with purslane supplementation based on the following factors: the type of purslane product (extract), the duration of the intervention (8 weeks), the gender of the participants (female), and the health status (overweight or obese) (Supplementary Table 3).

3.4.2. The Effects of Purslane Supplementation on BMI. Seven eligible studies, with a total of 379 participants, investigated the effect of purslane supplementation on BMI. Purslane supplementation significantly decreased BMI (WMD: −0.53 kg/m^2, 95% CI: −0.88–−0.18, and $P < 0.001$) (Figure 4). There was significant between-study heterogeneity ($I^2 = 842.7\%$ and $P < 0.001$). Subgroup analysis showed that purslane supplementation had a stronger effect on BMI in trials that met the following criteria: duration of treatment was 8 weeks, type of purslane product was extract, participants had MetS or obesity, mean age of participants was less than 40 years old, sample size was more than 60, and trials involved only female subjects (Supplementary Table 4).

3.4.3. The Effects of Purslane Supplementation on WC. Five eligible trials, with a total of 296 participants, investigated the effect of purslane supplementation on WC. The purslane group did not show a significant reduction in WC compared to the control group (WMD: −0.28 cm, 95% CI: −1.47–0.91, and $P = 0.23$), with high heterogeneity among the studies ($I^2 = 83.6\%$ and $P = 0.035$) (Figure 5). In

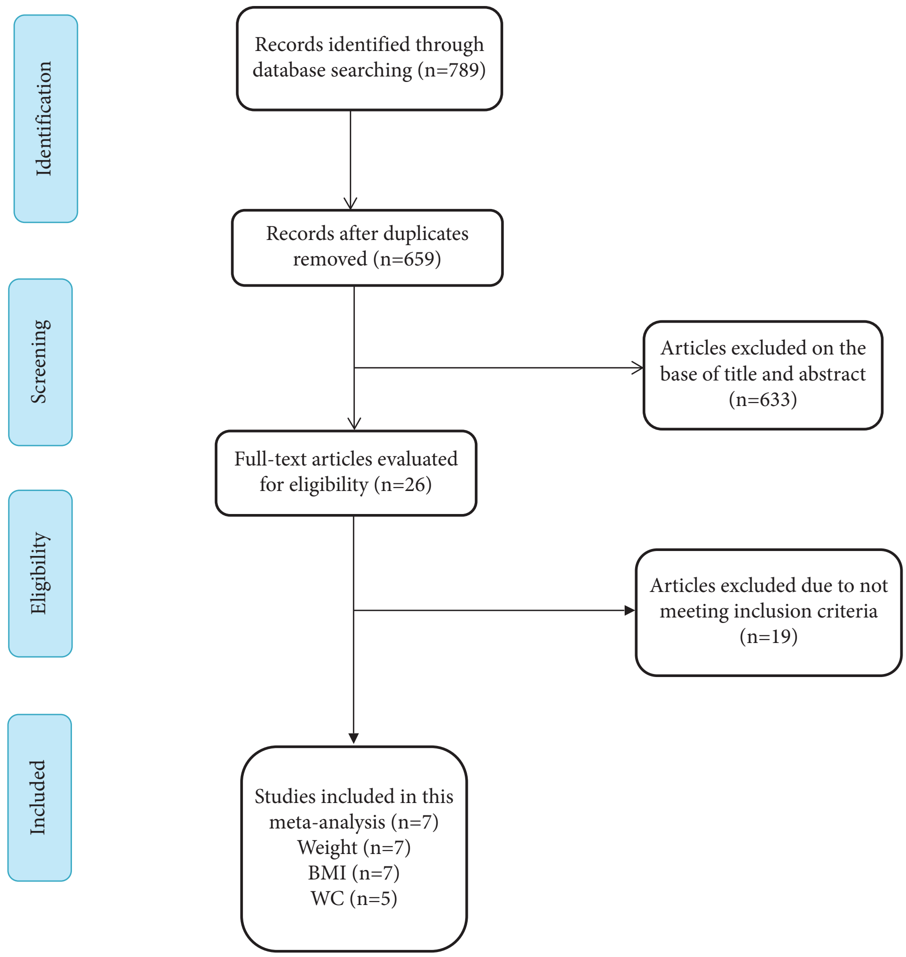

Figure 1: Flow diagram of study screening and selection process.

the subgroup analysis, the sample size, duration, gender, and health status of study participants explained this heterogeneity. Subgroup analysis indicated that purslane supplementation had a greater effect on WC in trials that met the following conditions: duration of treatment was 12 weeks, participants had MetS or obesity, and sample size was more than 60 (Supplementary Table 5).

3.5. Metaregression. To evaluate the influence of potential moderators on the estimated effect size, a meta-regression analysis was performed. Findings from the linear association revealed that the duration of treatment and sample size had no association with BW, BMI, and WC (Supplementary Figures 1a–1f).

3.6. Sensitivity Analysis. The sensitivity analysis results indicate that the overall estimates for BW, BMI, and WC remained unaffected by the exclusion of any individual study (Supplementary Figures 2a–2c).

3.7. Publication Bias. Visual inspection of the funnel plots indicated evidence of moderate asymmetry in the effects of purslane supplementation on obesity indices. In contrast, Egger's regression tests provided no evidence of publication bias for BW ($P = 0.597$), BMI ($P = 0.539$), and WC ($P = 0.942$) (Supplementary Figures 3a–3c).

4. Discussion

This meta-analysis is the first to evaluate the effect of purslane supplementation on obesity indices in adults. The findings indicated that purslane supplementation significantly decreased BW and BMI. A greater reduction was observed in some subgroups, such as those conducted on females, those lasting eight weeks, those using extracts, and those conducted on obese or MetS patients. However, this meta-analysis showed that purslane supplementation cannot affect WC in comparison with the control group, which may be attributed to the limited number of trials. Nevertheless, subgroup analysis showed that purslane supplementation significantly lowered WC in longer-term studies (12 weeks) and those with a larger sample size (≥60). On the other hand, the findings based on only two studies showed that purslane supplementation increased WC in eight weeks. The limited number of studies within each category may potentially result in biased estimates of treatment effects. As such, the findings should be interpreted with caution due to the small number of trials included in the analysis.

Table 1: Characteristic of included studies in the systematic review and meta-analysis.

First authors	Year/ country	Study design	Subject	Participants (intervention/ control)	Mean age (intervention/ control)	Baseline BMI (intervention/ control)	Duration (wk)	Type of administration		Main results
								Intervention	Placebo	
Adelnia Najafabadi et al.	2015/ Iran	Randomized controlled clinical trial	NAFLD	27/27	40.07/39.81	32.77/31.08	8	10 grams of purslane seeds + weight loss diet	Weight loss diet	Significant reductions in weight, WC, and hip circumference in both groups. Significant reductions in BMI only in the purslane group. The changes in hip circumference were significant between the two groups.
Darvish Damavandi et al.	2020/ Iran	Randomized, double-blind clinical trial	NAFLD	37/37	46.18/46.05	31.56/31.83	12	300 mg purslane extract	Placebo	There are no significant changes in weight, BMI, and WC.
Papoli et al.	2019/ Iran	Randomized clinical trial	Metabolic syndrome	32/32	42.16/43.16	28.23/26.30	12	10 grams purslane seed + 150 cc low-fat yogurt	150 cc low-fat yogurt	Significant reductions in weight and WC.
Ghorbanian et al.	2019/ Iran	Randomized clinical trial	Obese or overweight women	10/10	22.1/28.82	28.21/27	8	1200 mg purslane extract	Placebo	Significant reductions in fat mass and BMI.
Wainstein et al.	2016/ Israel	Double-blind, placebo-controlled clinical trial	Type 2 diabetes	31/32	52.4/58.3	29.9/29.1	12	180 mg/day purslane extract	Placebo	There are no significant changes in weight and BMI.
Esmaillzadeh et al.	2015/ Iran	Randomized controlled crossover clinical trial	Type 2 diabetes	48	51.4	28.99	12	10 g/day purslane seeds + 240 cc low-fat yogurt	240 cc low-fat yogurt	Significant reduction in weight and BMI.
Hosseini et al.	2015/ Iran	Randomized controlled clinical trial	Asthma	31/28	43.58/43.78	27.09/27.3	8	10 grams purslane seed + asthma treatment	Asthma treatment	There are no significant changes in weight, BMI, and WC.

NAFLD: nonalcoholic fatty liver disease; WC: waist circumference; BMI: body mass index.

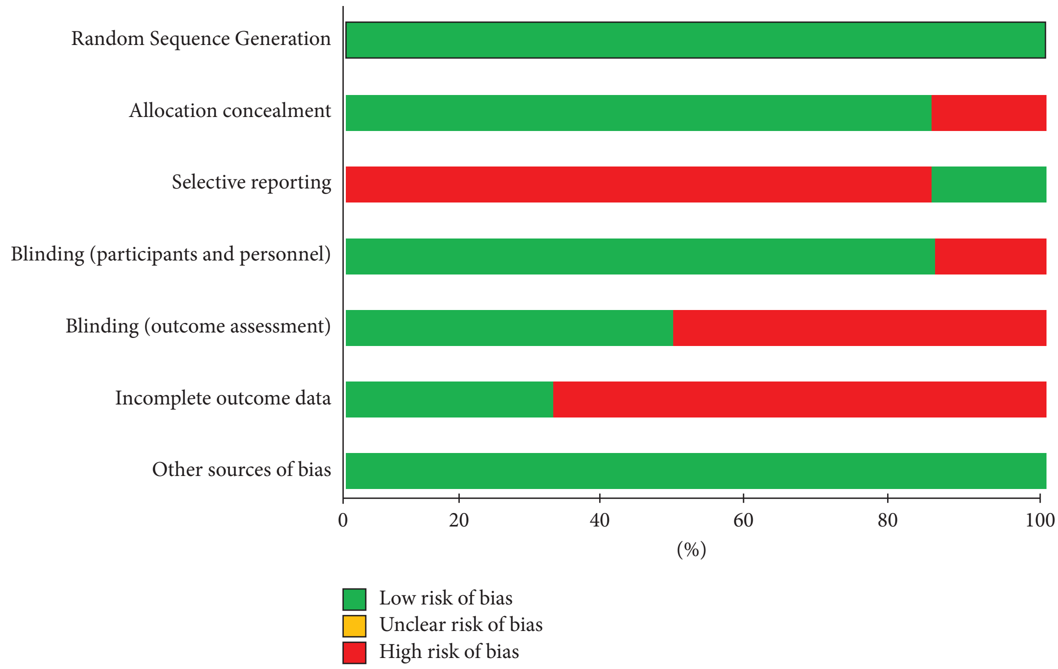

Figure 2: Results of risk-of-bias assessment for trials included in the current meta-analysis on the effects of purslane supplementation on obesity indices.

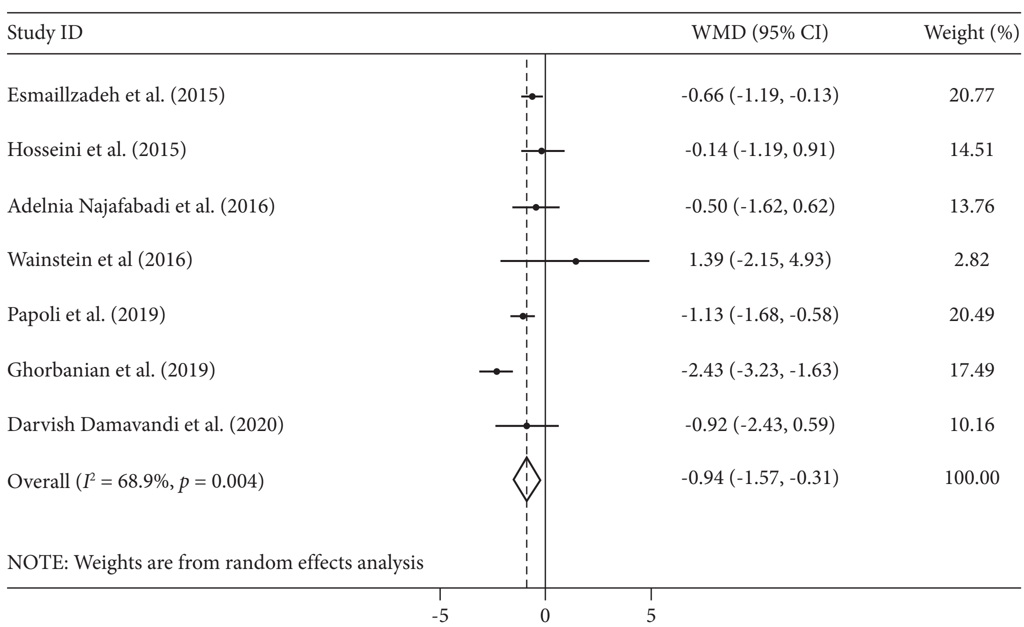

Figure 3: Forest plot illustrating weighted mean difference and 95% confidence intervals for the impact of purslane on BW.

Purslane has been used as a traditional medicine in various cultures for its health-promoting effects on disorders related to gastrointestinal, respiratory, hepatic, renal, neurological, and infectious diseases [33]. Its potential health benefits have been extensively studied in recent years, leading to a growing interest in its use as a functional food [34]. This meta-analysis assessed the effects of this plant on obesity indices and found a large and medium influence on BW and BMI, respectively. These results were similar to a clinical trial without a control group that was not included in the present analysis [21]. This study investigated the effects of 10 g of purslane seeds on T2DM patients and reported decreased BW and BMI after eight weeks of supplementation compared to the baseline. Moreover, some of the individual studies included in this analysis reported results that are in line with our findings [17, 23, 30]. For example, Ghorbanian et al. [30] indicated that 1200 mg purslane in the form of a supplement could effectively reduce BMI in obese or overweight women. However, in patients with asthma disease, 10 g of purslane seeds for eight

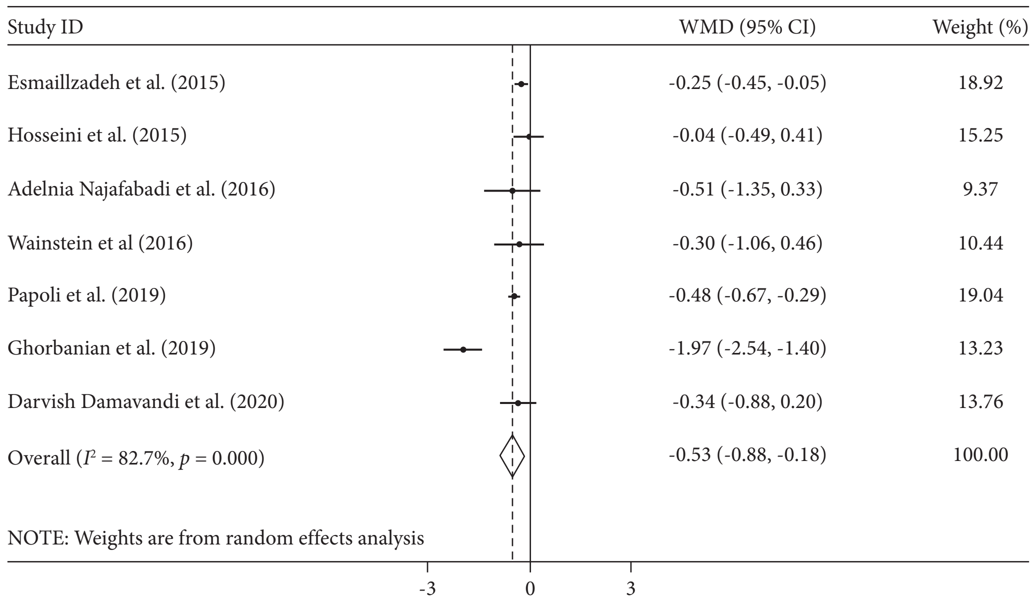

Figure 4: Forest plot illustrating weighted mean difference and 95% confidence intervals for the impact of purslane on BMI.

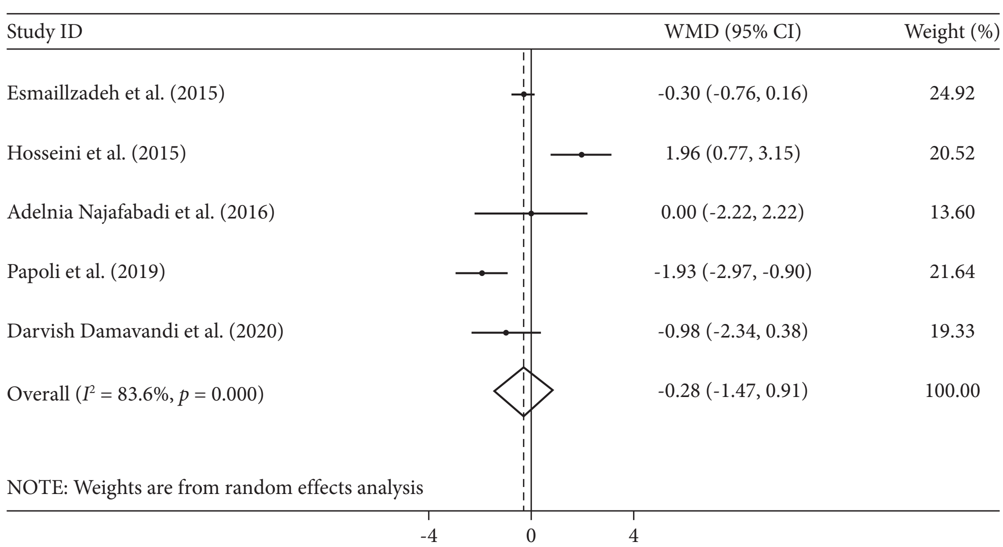

Figure 5: Forest plot illustrating weighted mean difference and 95% confidence intervals for the impact of purslane on WC.

weeks had no impact on BW, BMI, and WC, except for hip circumference [32]. Aliniya et al. [35] also reported no effect of 1 g/day purslane supplementation for 12 weeks on BMI, body fat percentage, and waist-to-hip ratio compared to control in obese postmenopausal women with NAFLD. In another study without a control group, 6 g/day purslane supplementation for four weeks did not change the BW of normal-weight hypercholesterolemic adults [36]. Differences in the study population, as well as the dose and duration of supplementations, may account for this conflicting evidence. The findings are also supported by a meta-analysis including 10 randomized, double-blind, placebo-controlled studies showing that supplementation with alpha-lipoic acid (ALA), a supplement with antioxidant properties, can lower BMI and BW [37]. In another meta-analysis, the ALA supplement significantly reduced BW and BMI compared with a placebo group, but its effects on WC were not significant [38]. In this meta-analysis study, it was also found that weight loss was greater in studies lasting less than 10 weeks compared to longer-term studies [38]. In prior open-label studies, ALA supplementation has been shown to effectively reduce the weight of overweight and obese individuals [39, 40]. In addition, the presence of thiamine in purslane may explain why purslane could be more effective in obese, MetS, and diabetic patients. Thiamin is a coenzyme that plays an important role in converting carbohydrates, fats, and proteins into energy, and studies indicate that obese and diabetic patients often have low levels of thiamin [21, 41, 42]. Hence, purslane consumption may help to alleviate this thiamine deficiency.

The results are also consistent with the findings of previous studies conducted on animal models. Jung et al. [43] investigated the effects of a diet containing 5% and 10% purslane powder on high-fat diet-induced obese mice and demonstrated reduced weight gain and visceral fat with a high dose after 12 weeks. In a different study, administering fresh purslane for eight weeks reduced the adipose tissue weight in obese albino rats [44]. However, Won and Kim found no significant effect of orally administering 75 and 125 mg/kg of the ethanol extract of purslane for four weeks on weight gain and feed intake in male C57BL/6J mice with high-fat diet-induced obesity. Nevertheless, they reported a significant improvement in the feed efficiency ratio (BW gain/food intake) with purslane administration [45]. The contradictory evidence could partially be attributed to the differences in the dose and duration of purslane supplementation and the type of used animals.

Purslane has been associated with plausible mechanisms that have antiobesity effects. Given the significant roles of oxidative stress and inflammation in the development and progression of obesity, the potential protective effects of purslane against obesity and its related complications could be attributed to its antioxidant and anti-inflammatory properties [18, 46]. The previous literature has also suggested that purslane can positively impact insulin resistance [47], leading to potential improvements in weight management [48]. Furthermore, purslane could stimulate AMP-activated protein kinase (AMPK) phosphorylation in adipocytes [49]. AMPK acts as a cellular regulator of energy homeostasis. Its activation in the adipose tissue stimulates the browning process, energy expenditure, glucose uptake, adiponectin secretion, and fatty acid oxidation, while simultaneously suppressing lipogenesis, lipolysis, and secretion of proinflammatory markers [50, 51]. Therefore, AMPK activation by purslane protects against obesity and its associated metabolic dysfunctions. The supplementation of purslane has also been linked to the upregulation of hepatic peroxisome proliferator-activated receptor (PPAR)-α [43, 52], which is known to suppress the growth and differentiation of adipocytes while promoting lipolysis and fatty acid oxidation [53]. As another potential mechanism, fresh purslane could increase hepatic cholesterol 7a-hydroxylase (CYP7A1) expression and, subsequently, bile acids formation [44].

Evidence supports the beneficial effects of bile acids on improving various parameters associated with MetS [54]. The bioactive components in purslane, including carotenoids, flavonoids, saponins, omega 3, and thiamin, are thought to be responsible for its antiobesity effects [55]. The administration of homoisoflavonoids extracted from purslane to 3 T3-L1 preadipocytes resulted in a reduction in lipid accumulation as well as the down-regulation of adipogenic transcription factors, including PPAR-γ and CCAAT/enhancer-binding proteins (C/EBPα), along with adipogenic target genes [56]. However, further research should be conducted to shed light on the other associated mechanisms of the antiobesity effects of purslane.

4.1. Side Effects. Only a few studies have assessed the potential side effects of purslane. It has been reported that purslane contains high levels of oxalate, which can lead to hyperoxaluria and an increased risk of calcium oxalate crystals and kidney stones [57]. A recent case report discovered that the consumption of 0.75 kg of purslane in a single meal led to oxalate nephropathy [58]. It is suggested that consuming purslane alongside yogurt may reduce the absorption of soluble oxalate [57]. Nevertheless, it is still questionable to recommend daily consumption of purslane.

4.2. Strength and Limitations. This study was the first to systematically assess the effects of purslane on obesity indices. The present study was conducted strictly according to the PRISMA guidelines [24] and observed significant effects of purslane on BW and BMI. No evidence of publication bias was observed in this meta-analysis, as determined by the Egger regression test [28]. In addition, exploring the sources of heterogeneity and assessing the certainty of evidence are other strengths of this study [59]. The evidence for BW and BMI was graded as having moderate certainty. However, it is important to acknowledge several limitations that should be taken into consideration when interpreting the results. First, there was significant methodological and statistical heterogeneity among the included studies [59]. This heterogeneity was particularly evident in the form of purslane supplementation, which varied from seeds [17, 22, 23, 30, 32] to extracts [29–31] across studies. Second, a limited number of studies and participants were involved in the analysis [17, 22, 23, 29–32]. This limitation is especially relevant when considering WC, as only five studies [17, 22, 23, 29, 32] were available for analysis. Third, most of the included studies were performed in Iran [17, 22, 23, 29, 30, 32], which may restrict the generalizability of the findings to other regions and populations. Finally, it should be noted that most of the studies included in meta-analysis focused on diverse health conditions such as MetS [23], T2DM [17, 31], asthma [32], NAFLD [22, 29], and obese or overweight women [30] and did not have a primary aim of examining the antiobesity effects of purslane [17, 22, 23, 29–31].

5. Conclusion

This meta-analysis concludes that purslane supplementation has a significant effect on BMI and BW but not on WC in adults, indicating its potential therapeutic use. However, subgroup analysis showed that purslane supplementation significantly lowered WC in longer-term studies (12 weeks) and those with a larger sample size (≥60). Furthermore, the pooled results of previous RCTs showed that purslane is a safe and efficacious intervention for reducing obesity indices in subjects with MetS or obesity. Therefore, the consumption of purslane may have indirectly contributed to the amelioration of clinical symptoms in diseases with metabolic disorders, owing to its impact on some obesity indices. However, given the limitations and the low number of included studies in the present meta-analysis, more large-scale RCTs with better methodological designs are warranted to confirm the efficacy and safety.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Ethical Approval

The study protocol was approved and registered by the Ethics Committee of Isfahan University of Medical Sciences (IR.MUI.RESEARCH.REC.1402.108). The protocol of the current study has been registered in the PROSPERO system (CRD42023426343).

Disclosure

Mahdi Vajdi and Shirin Hassanizadeh share a first authorship.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

All authors have read and approved the manuscript. MV and SH were the main researchers who designed the hypothesis and supervised the project. MV and SSZ conducted the literature search and screening of data. MV, SH, MB, and GA performed data extraction and quality assessment independently. MV, SH, SSZ, MB, and GA analyzed and interpreted data and wrote the manuscript. Mahdi Vajdi and Shirin Hassanizadeh have contributed equally to this work.

Acknowledgments

The financial support of the Student Research Committee, Isfahan University of Medical Sciences, is gratefully acknowledged. The present study was performed by a grant from the Student Research Committee, Isfahan University of Medical Sciences (grant number: 140275).

Supplementary Materials

Supplementary Table 1: PRISMA checklist. Supplementary Table 2: GRADE approach summary of findings and quality of evidence assessment. Supplementary Table 3: results of subgroup analyses for the effects of purslane supplementation on body weight according to intervention or participant characteristics. Supplementary Table 4: results of subgroup analyses for the effects of purslane supplementation on BMI according to intervention or participant characteristics. Supplementary Table 5: results of subgroup analyses for the effects of purslane supplementation on WC according to intervention or participant characteristics. Supplementary Figure 1: random effects of meta-regression plots of the association between mean changes in weight (a, b), BMI (c, d), WC (e, f), and intervention duration and sample size. Supplementary Figure 2: sensitivity analysis of purslane on weight (a), BMI (b), and WC (c). Supplementary Figure 3: funnel plot (with pseudo 95% CIs) of the WMD versus the se (WMD) for studies evaluating the association between purslane supplementation and weight (a), BMI (b), and WC (c) values. (*Supplementary Materials*)

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