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Systematic Review

Are Isolated and Complex Fiber Supplements Good Choices for Weight Management? A Systematic Review

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Abstract

Background: Previous trials have reported beneficial effects of isolated and complex fiber supplements in obesity treatment. However, recommending fiber supplements in obese subjects remains controversial. To the best of our knowledge, no systematic review has updated the data on the effects of fiber supplements on obesity since 2010 and the need exists for a systematic review on this topic. Accordingly, a systematic review was undertaken to summarize the efficacy of different types of fiber supplements as a complementary treatment for weight management.

Methods: We searched PubMed, Scopus, Cochrane Library and Google Scholar between January 2010 to August 2016 with no language restriction. Considering the inclusion/exclusion criteria and quality assessment score, finally 17 clinical trials met the eligibility criteria and were included.

Results: The present study indicated that the efficacy of various fiber supplements on losing weight is variable. Several mechanisms related to physicochemical properties of fibers such as solubility, fermentability and viscosity rates can be involved in their anti-obesity effects. Dextrin, Mannan (gum Arabic) and pectin-rich fiber (lupin kernel) with no dietary interventions indicated a reduction in body weight and energy intake, while from clinical point of view, their effects were not considerable.

Conclusion: Overall, findings indicated that the efficacy of fiber supplements on obesity management is dependent on their contents and physicochemical properties. It seems that fiber supplements with no weight-loss interventions did not have considerable anti-obesity effects. However, due to limited studies on each type of fiber, findings should be declared by caution. Additional research is needed on comparison of different fiber supplements in similar conditions to clarify the best type and dosage of fiber supplement as a complementary therapy in obesity management.

Keywords: Appetite, Fiber supplement, Physicochemical property, Weight management

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Introduction

Obesity is currently recognized as one of the most important threats for health. It can provide a ground for developing a number of chronic diseases including cardiovascular diseases, diabetes, dyslipidemia, and some types of cancer.[1,2] Due to dramatic increase in obesity prevalence, researchers attempt to find effective complementary therapies for obesity and its complications. Taking different supplements is a treatment for obesity management.[3] Previous studies have shown that intake of fiber-rich foods is inversely associated with obesity and adiposity indicators.[4,5] According to the Institute of Medicine (IOM), total fiber intake is determined by 2 components: dietary fiber and functional fiber. Dietary fiber comprises indigestible carbohydrate and lignin, which are usually found in plants. Functional fiber includes isolated and indigestible carbohydrates that have positive effects on human health.[6] For adults, the recommended adequate dietary fiber intake is 14 g per 1000 kcal/d.[7] However, most people do not consume enough foods with adequate amounts of fiber to meet this recommended level,[8,9] and particularly obese subjects report lower intake of dietary fiber than normal weight individuals.[7] Whole grains can be a main source for dietary fiber, especially in Asian populations. However, people mostly consume refined grains, resulting in insufficient intake of adequate fiber.[8,9] Some clinical trials have reported that fiber supplements (alone or along

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with lifestyle modifications) can positively influence anthropometric indices, appetite, and energy intake.[10–14]

Several potential mechanisms have been suggested for the anti-obesity properties of fibers based on the types of fiber being consumed. The primary mechanism is related to reduction in energy intake and increased feeling of satiety.[5,15] Dietary fibers can delay gastric emptying and intestinal transit time.[16,17] They help consumption of healthy foods in place of less healthy foods[5] and reduce energy density of meals.[10,11] Dietary energy density is directly associated with the risk of obesity. Therefore, dietary fiber can be helpful for weight management.[18] Foods rich in fibers generally need to be chewed longer, affecting sensory fullness and reducing the amount of food eaten in a meal.[11] Additionally, some types of fiber enhance beneficial bacterial growth and produce short-chain fatty acids (SCFAs), which reduce appetite via several mechanisms.[12,15,19-22] Therefore, they are considered as prebiotics.

Although the beneficial effects of fiber supplements on obesity have been reported in some previous trials, several studies revealed no differences between the effects of fiber supplements and placebo for obesity management. Thus, recommending fiber supplements for obese subjects remains controversial. It seems that dosages and types of fiber are involved in the effects of fiber supplements on weight management.[23-27] Four main physicochemical properties, including solubility, gel formation, degree or rate of fermentation, and viscosity of fiber supplements affect their clinical efficacy.

Wanders et al summarized the effects of different types of fiber on obesity management in a systematic review (up to February 2010).[27] However, to the best of our knowledge, no systematic review has updated the data on the effects of fiber supplements on body weight and other anthropometric indices in recent years. Due to the increasing number of clinical trials conducted from 2010 to 2016 on the efficacy of fiber supplements on obesity, the need exists for a systematic review on this topic. Accordingly, we conducted the present study to summarize the available literature on the efficacy of isolated and complex fiber supplements as a complementary therapy in adults compared to the placebo or other interventions for obesity management.

Materials and Methods

This systematic review was conducted based on the principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Statement (PRISMA).[28]

Selection of Literature

We conducted a systematic literature search between January 2010 to August 2016. The last systematic review on this topic summarized data up to 2010[27]; therefore, we limited our search to the period spanning 2010 to August 2016 with no language limitation. PubMed, Scopus), Cochran Library and Google Scholar databases were searched for clinical trials evaluating the effects of fiber supplement on obesity management. Body weight was considered as a primary outcome. For searching types of fiber and their effects, classifications of dietary fibers[27] (see Table 1) was used in combination with the search terms "weight" OR "obesity" OR "energy intake" OR "dietary intake" in the primary search strategy and in a subsequent medical subheading (MESH) and free terms search. The search strategy was limited to title and abstracts of the publications. We also performed a manual search for reference lists of relevant papers and narrative reviews.

Inclusion and Exclusion Criteria

The inclusion criteria were: (1) clinical trials, (2) parallel or cross-over design studies and (3) studies on fiber supplements (not fiber-fortified products). Studies were

Table 1. Fiber Classification and Their Physicochemical Properties

Fiber				
		Isolated Fibers		
Glucans • Cellulose • Methyl cellulose[a] • Ethyl hydroxyl ethyl cellulose[b,c] • Beta-glucan[a,b,c]	Resistant starch • Type 2[a] • Type 3[a]	Dextrins • Polydextrose[a,b] • Dextrin[a,b] • Reuteran[a,b] • α-Cyclodextrin[a,b]	Mannans • Guar gum[a,c] • Locust bean gum[a,b,c] • Fenugreek gum[a,b,c] • Konjac glucomannan[a,b,c]	Fructans • Inulin[a,b] • Fructooligosaccharide[a]
XylansArabinoxylan[a] • Xylooligosaccharides[a,b]	Pectin	Marine polysaccharides • Alginates[b,c] • Carrageenan Agar[b,c]	Chitosan	
		Complex Fiber		
Pectin-rich • Beet fiber[b,c] • Lupin kernel fiber[b,c]	**Arabinoxylan-rich** • Psyllium fiber[b,c] • Wheat fiber • Rye fiber • Corn fiber	**Beta-glucan-rich** • Oat fiber[b,c] • Barely fiber[b,c]		

[a] More fermentable fiber; [b] More soluble fiber; [c] More viscous fiber.

excluded if they did not evaluate body weight or were performed on animal/in vitro models.

Considering the inclusion/exclusion criteria and search strategy, 2 reviewers independently evaluated the papers. First, they screened the papers based on title and categorized them into three groups: relevant, irrelevant and unsure. In the second step, the abstracts of publications in relevant and unsure groups were screened using the defined criteria. Papers classified as excluded publications by both reviewers were eliminated from additional evaluation. Then, each reviewer independently reviewed the full text of the remaining relevant papers.

Data Extraction

Data were extracted from included papers and entered into data sheets. From each paper, the following information was extracted: first author's name, publication year, study design (parallel/crossover), blinding, sample size, sample demographics (age, sex, body mass index [BMI], disease), advice or dietary recommendation, type of fiber, dosage, duration of study and outcome (all reported data on anthropometric indices, body composition, energy intake, appetite and satiety hormones). Since body weight was considered as the primary outcome for the present systematic review, studies that did not report body weight variable were excluded. If anthropometric indices or energy intake evaluations were repeated at several time intervals, only data related to final measurements were extracted.

Assessment of Study Quality

Critical appraisal for assessing methodological quality of each paper was performed using Verhagen checklist[29] by both reviewers. Then, the list of included papers by each reviewer was compared and nonconformities were discussed to make a final decision. Verhagen checklist consists of 8-item as follows: (1) method of randomization & allocation concealment, (2) similarity of prognostic indicators at baseline, (3) considering eligibility criteria, (4) blinding of assessors, (5) providers and (6) participants, (7) considering point estimates for outcome measures and (8) including intention-to-treat analysis. Score of each item was 1 and 0 for "Yes" and "No/do not know" answer, respectively. Papers scoring at least 5 (out of 8) were included in the systematic review. The methodological characteristics of each included paper are presented in Table 2.

Results

Summary of Included Studies

The primary literature search that was restricted to human study between 2010 and August 2016 identified 375 publications (including 147 duplications). Of these, 170 papers were excluded in the title and abstract evaluation step. The excluded papers were review papers (n = 8), irrelevant publications (n = 115) and studies

Table 2. Scores of Quality Assessment for Each Included Study

Study	Was A Method of Randomization Performed?	Was the Treatment Allocation Concealments?	Were the Groups Similar at Baseline?	Were the Eligibility Criteria Specified?	Was the Outcome Assessor Blinded?	Was the Care Provider Blinded?	Was the Patient Blinded?	Were Point Estimates and Measures of Variability Presented for the Primary Outcome Measures?	Did the Analysis Include ITT[a]?	Total Score
Mosikanon et al[31]	1	0	1	1	0	1	1	1	0	**6**
Karimi et al[32]	1	1	1	1	0	0	0	1	0	**5**
Aliasgharzadeh et al[12]	0	1	1	1	1	1	1	1	0	**7**
Guess et al[36]	1	1	1	1	0	1	0	1	0	**6**
Liber et al[37]	1	1	1	1	0	1	1	1	0	**7**
Fenchner et al[21]	1	1	0	1	0	1	1	1	0	**6**
Ibrugger et al[30]	1	0	1	1	0	0	1	1	0	**5**
Keithley et al[33]	1	0	1	1	0	1	1	1	0	**6**
Pourghasem et al[35]	0	0	1	1	1	1	1	1	0	**6**
Dewulf et al[20]	1	0	1	1	0	1	1	1	0	**6**
Babiker et al[34]	1	1	1	1	0	1	1	1	1	**8**
Georg et al[38]	0	0	1	1	0	1	1	1	1	**6**
De bock et al[16]	1	1	1	1	0	0	1	1	0	**6**
Lyon et al [42]	1	0	1	1	1	1	1	1	0	**7**
Guerin et al[14]	1	0	1	1	0	1	1	1	0	**6**
Daud et al[17]	0	0	1	1	0	1	1	1	0	**5**
Cicero et al[39]	0	0	1	1	0	0	1	1	1	**5**

[a] Intention-to-teat.

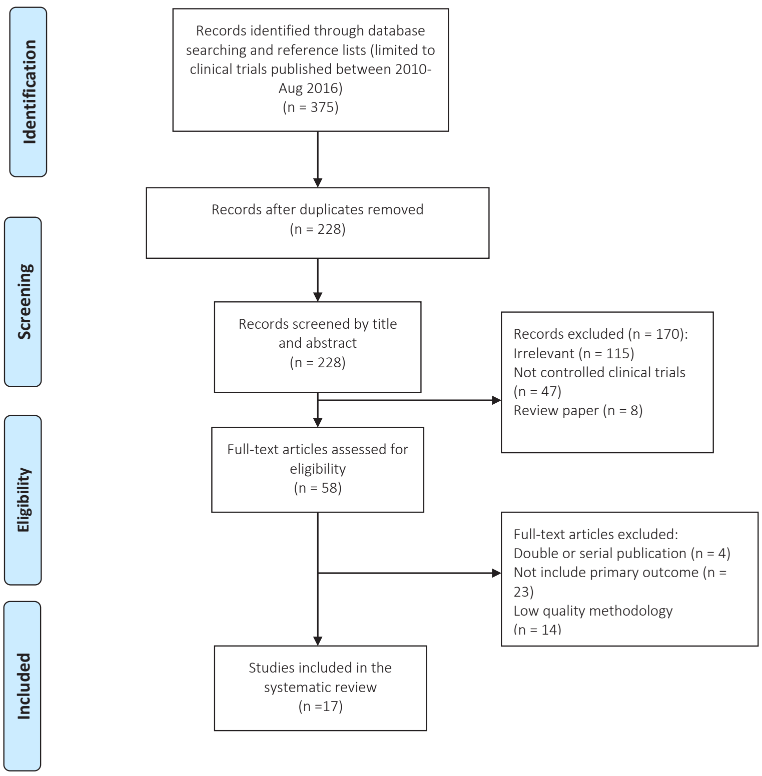

Figure 1. Flow Diagram of the Included Studies.

with no clinical trial design (n = 47). The full texts of the remaining 58 publications were evaluated. Double or serial publications (n = 4), studies that did not include primary outcome (n = 23) and studies with low quality methodology (n = 14) were excluded. Finally, 17 clinical trials were eligible for systematic review. Figure 1 demonstrates the publication selection steps.

Detailed characteristics of the included clinical trials are shown in Table 3. Clinical trials were classified on the basis of fiber groups (Table 1). Numbers of eligible papers in each fiber group are as follows: β-glucan (n = 2), resistant starch (RS) (n = 1), dextrin (n = 2), mannan (n = 3), fructan (n = 5), Marine polysaccharide (n = 1), pectin-rich (n = 1) and arabinoxylan-rich (n = 2).

Most papers (n = 13) evaluated the effects of fiber supplement alone, with no calorie restricted diet or life style modifications. Out of 17 eligible papers, 9 clinical trials (irrelevant to fiber groups and recommended dosages) indicated positive effect of supplementation with fiber on weight loss compared to the placebo groups.

Beta-Glucan Fiber

In a cross-over study, Ibrugger et al compared the effects of three types of β-glucan sources (extracted from oat, barley, and barley mutant) on healthy adults. They indicated no significant changes in body weight after supplementation with 3.3 g/d of each sources.[30] Mosikanon et al also evaluated the effects of yeast β-glucan supplement on subjects with BMI ≥23 kg/m^2. They indicated that supplementation did not change energy intake, body weight or BMI. However, waist circumference (WC) decreased significantly after 6 weeks of the intervention compared to the placebo group (-3.5 cm vs. +1.0 cm).[31] Changes in only body size were likely to be due to low dosage or short-term treatment.

Resistant Starch

Only one paper evaluated the effects of RS on body weight. Karimi et al reported that Hi-Maize® 260 supplement, a type of RS2, did not change body weight, BMI or energy intake in patients with type 2 diabetes after 8 weeks.[32]

Dextrins

In dextrin group, 2 studies evaluated the effects of resistant dextrin, named NUTRIOSE®.[12,14] According to the study conducted by Guerin et al, 34 g/d NUTRIOSE® mixed with 250 mL orange juice decreased hunger feeling, energy intake (-3079 kJ/d), body weight (-1.5 kg), fat mass (-0.3%) and BMI (-0.5 kg/m^2) after 12 weeks. Reduction in body weight was greater in the intervention group compared to the control group at the end of 12 weeks (-1.5 kg).[14] Aliasgharzadeh et al also demonstrated that supplementation with NUTRIOSE® decreased energy intake (-1400 vs. -700 kJ/d), body weight (-2.9 vs. -1.6 kg) and BMI (-1.4 vs. -0.9 kg/m^2) in females with type 2 diabetes compared to the placebo group. However, they did not evaluate hunger and fullness feeling.[12]

Table 3. Study Characteristics of Different Groups of fiber on weight Management

Fiber Group	Author, Date	Fiber Type	Dose (g/d)	Duration (wk)	Sample size & characteristics	Design	Blinding	Diet/Advice	Outcome
β-Glucan	Ibrugger et al, 2013[30]	3 types of beta-glucan	3.3	Four 3-wk	60 adults	R/P Cross-over	Single	No	-Wt
	Mosikanon et al, 2016[31]	Yeast beta-glucan	477 mg	6	44 overweight and obese subjects BMI ≥23 kg/m^2	R/P/P	Double	Not clear	-Energy intake -Wt, BMI ↓WC
Resistant starch	Karimi et al, 2015[32]	Hi-Maize 260 (RS2)	10	8	56 type 2 diabetic females	R/P/P	Triple	No	-Wt, BMI, energy intake
Dextrin	Guerin et al, 2011[14]	NUTRIOSE	34	12	100 overweight healthy adults BMI = 24–28 kg/m^2	R/P/P	Double	Not clear	↓Wt, BMI ↓FM ↓Energy intake, ↓Hunger
	Aliasgharzadeh et al, 2015[12]	NUTRIOSE	10	8	55 type 2 diabetic females BMI = 25–35 kg/m^2	R/P/P	Triple	No	↓Wt, BMI, ↓Energy intake
Mannan Glucomannan	Keithley et al, 2013[33]	Glucomannan	1.3	8	53 overweight and obese subjects 25 ≤ BMI ≤35 kg/m^2	R/P/P	Double	Not clear	-Wt, BMI, WC, -Hunger & fullness
Mannan Gum Arabic	Babiker et al, 2012[34]	Gum Arabic	30	6	120 healthy females	R/P/P	Double	No	↓Wt, BMI,FM
Mannan PolyGlycoplex (PGX)	Lyon et al, 2011[42]	PGX	5-15	15	Overweight and Obese subjects (BMI = 27–35 kg/m^2)	R/P/P	Double	No	↓Wt ↓HC (in females)
Fructan Inulin	Dewulf et al, 2013 [20]	Inulin/FOS (1:1)	16	12	44 obese women (BMI >30 kg/m^2)	R/P/P	Double	Not clear	-Wt
	Pourghasem et al, 2013[33]	High performance	10	8	49 type2 diabetes females 25 < BMI < 35 kg/m^2	R/P/P	Triple	No	↓Wt ↓ BMI ↓Energy intake
	Guess et al, 2015[36]	Inulin	30	18	44 pre-diabetic patients 25 < BMI < 35 kg/m^2	R/P	Double	Calorie restricted diet	↓Wt -Energy intake Hunger/Fullness
Fructan FOS	Daud et al, 2011[17]	Oligofructose	30	8	22 healthy subjects 25 < BMI < 35 kg/m^2	R/P/P	Double	Not clear	-Wt -Energy intake -PYY ↓Subjective appetite
	Liber et al, 2014[37]	Oligofructose	7-11y: 8 g 12-18 y: 15g	12	97 overweight and obese children	R/P/P	Double	Dietary recommendation & increasing physical activity level	-Wt, BMI -FM -Energy intake
Alginate	Georg et al, 2012[38]	Soduim alginate	15	12	96 obese subjects BMI = 30–45 kg/m^2	R/P/P	Double	Calorie restricted diet	↓Wt, FM -WC
Lupin kernel	Fenchner et al, 2014[21]	Lupin kernel in comparison to citrus fiber	25	4 wk (2 wk wash out) 3 groups	60 moderately hypercholesterolemia adults	R Cross-over	Double	No	↓Wt, WC, FM, Energy intake in both groups
Psyllium	Cicero et al, 2010[39]	Psyllium vs. guar gum hydrolyzed	3.5	24	141 metabolic syndrome patients	R/P/P	Single	Step II diet (American Heart Association)	↓Wt ↓BMI
	de Bock et al, 2012[16]	Psyllium	6	6 wk (2 wk wash out)	47 adolescent at risk for metabolic syndrome	R/P cross-over	Single	Not clear	-Wt ↓Central adiposity

R/P = Randomized/placebo; R/P/P = randomized/placebo/parallel; Wt = Weight; WC = waist circumference; HC = hip circumference; BMI = body mass index; FM = fat mass; FOS = fructooligosaccharides.

in females with BMI>30 kg/m^2.[20] However, according to the study by Pourghasem et al, high performance inulin decreased energy intake (-276 kcal/d), body weight (-2.6 kg) and BMI (-0.9 kg/m^2) compared to the placebo group in females with type 2 diabetes after 8 weeks of the intervention.[35] Guess et al also evaluated supplementation with inulin in pre-diabetic patients with BMI between 25 to 35 kg/m^2. During weeks 1–9 (weight loss phase), body weight in both groups decreased (-4.6 vs. -3.6 kg). However, between 10 and 18 weeks (weight maintenance phase), reduction in body weight of inulin group compared to the placebo group was the greatest (-1.8 vs. -0.5 kg). Fat mass at weeks 9 and 18 showed a greater reduction in the inulin group compared to the placebo group (-2.8 vs. -1.2%) and (-3.7 vs. -1.1%), respectively. No changes were reported in subjective appetite and food intake from *ad libitum* meal at week 18 of the intervention.[36] However, Daud et al reported that 30 g/d oligofructose did not change body weight, energy intake, serum levels of peptide YY (NPY) and subjective appetite after 8 weeks. However, supplementation reduced hunger feeling and motivation to eat compared to the placebo group.[17] Liber et al also indicated that supplementation with oligofructose did not change energy intake, body weight, BMI and fat mass in overweight and obese children (BMI >85th percentile) after 3 months.[37]

Alginate

Another evaluated isolated fiber in the present systematic review was alginate. Alginate belongs to the marine polysaccharide group and only one study evaluated its effect on energy intake and anthropometric indices. George et al concluded that sodium alginate supplementation in combination with energy restriction (-300 kcal/d) decreased weight (-6.7 vs. 5.0 kg) and FM (-5.1 vs. -3.8 kg) compared to the placebo with no changes in WC and serum level of ghrelin hormone in obese subjects (BMI = 30–45 kg/m^2).[38]

Pectin-Rich

From the complex fiber group, one clinical trial on pectin-rich (lupin kernel) and 2 studies on arabinoxylan-rich (psylluim) were included to the final step of evaluation. In a randomized, cross-over trial by Fechner et al, subjects with moderately hypercholesterolemia passed 3 intervention periods with a 2-week washout phase. They consumed either a high-fiubj diet (25-g/d lupin kernel fiber or citrus fiber) or a low-fiber diet (control). Both interventions decreased energy intake (-3.6 vs. -3.2 MJ/d), body weight (-0.8 kg vs -0.6 kg), WC (-2.6 cm vs. -2.1 cm) and FM (-0.38 kg vs. -0.27 kg) compared to the control group.[21] Cicero et al also demonstrated that psyllium vs. guar gum hydrolyzed decreased body weight (-3.3 kg vs. -1.6 kg), WC (-4.1 cm vs. -4.2 cm) and BMI (-2.9% vs. -3.3%) after 6 months in subjects with metabolic syndrome.[39] However, de Bock et al in a cross-over study indicated that supplementation with psyllium reduced central adiposity with no changes on body weight in adolescents with the greater risk of developing metabolic syndrome after 8 weeks.[16]

Discussion

The present systematic review of clinical trials indicated that different types of fiber affect body weight, body composition, energy intake and appetite differently. The efficacy of fiber supplement for obesity management is dependent on content and physicochemical properties of fibers such as solubility, fermentability and viscosity rates. Dextrin, mannan (gum Arabic) and pectin-rich fiber (lupin kernel) with no dietary interventions demonstrated a reduction in body weight and energy intake, while from the clinical point of view, their effects were not considerable. However, due to limited studies for each type of fiber supplement, we cannot draw a definite conclusion about their efficacy in obesity management.

Across the clinical trials, the greatest reduction in body weight following supplementation with fiber (resistant dextrin) was 1.5 kg after 12 weeks of the intervention. However, from the clinical point of view, it was not very notable. Dextrin, mannan (gum Arabic) and pectin-rich fiber (lupin kernel) with no dietary interventions showed a reduction in body weight and energy intake. Changes in FM were reported in only one study of each aforesaid type of fiber supplement. Therefore, their efficacy in body composition improvement remained unclear. Moreover, due to the evaluation of WC and HC in only one study, we could not judge their effects on body size.

Four studies evaluated the effects of fiber supplements concurrent with life style modifications or calorie restricted diets on body weight. Among them, sodium alginate indicated the highest effect rate on losing weight (-1.7 kg throughout 12 weeks) which was 0.56 kg/mon.[40] It also decreased FM with no significant reduction in WC.[40] Based on the findings, fiber supplements cannot play a notable anti-obesity role. Due to differences in methodology, types of fiber, dosages, duration of study, participants' characteristics in different reports, and limited studies in each fiber group, drawing a definite conclusion about the best fiber supplement for obesity management was difficult.

In the present study, NUTRIOSE®, gum Arabic and lupin kernel fibers with no other obesity treatment indicated a helpful but not impressive effect on weight management. Both studies that evaluated the effects of NUTRIOSE® reported a reduction in body weight, BMI and energy intake after the intervention.[12,14] FM was measured in one study and positive effects were reported.[14] The studies were randomized, placebo-controlled trials and researchers and participants were blinded to allocation. Therefore, less bias can affect the findings. NUTRIOSE® is a resistant dextrin with glucose polysaccharides (rich in α-1,4 and α-1,6 linkages) prepared from maize, wheat or other edible starch which is produced at a high temperature.[14] Based on fiber classification (Table 1), dextrins are more soluble and more fermentable. These physicochemical properties can contribute to the reduction in the feeling of huger and energy intake.[41] Dextrins are a kind of prebiotics; therefore, they can be fermented in the colon and change gut flora. SFCAs as fermentation products, especially butyrate, can stimulate secretion of the leptin hormone and affect ghrelin, NPP and glucagon-like peptide (GLP)-1. Through regulation of satiety hormones, dextrins can control appetite and energy intake.[12,14] Additionally, resistant dextrin may reduce body weight through the reduction in metabolic endotoxemia. Endotoxemia may be involved in low-grade inflammation, insulin resistance and adipocyte hyperplasia. Therefore, it can be a good target in obesity management.[12]

In the present study, of three trials on Mannans, 2 indicated reduction in body weight. Gum Arabic[34] and polyglycoplex (PGX)[42] with no changes in diet decreased body weight. Moreover, it was reported that gum Arabic reduced BMI and FM in healthy females.[42] PGX is a fiber supplement which is composed of konjac powder, xanthan gum and sodium alginate. These 3 fibers are water-soluble polysaccharides. They act synergistically and form strong bonds. The viscosity level of this combination is three to five times higher than other individual polysaccharides. In the study by Lyon et al, PGX decreased body weight and hip circumference in females only.[42] However, it is not clear why the supplementation did not change anthropometric indices in overweight and obese men. It seems that the recommended dosage was insufficient to show weight-loss effects in men. The effects of PGX on weight and body size might be related to its high viscosity. This characteristic can slow gastric emptying, food intake and increase satiety.[42]

All the studies were double-blind, randomized, placebo-controlled trials and evaluated the effects of different types of mannan fibers on overweight or obese subjects with no chronic diseases**.** The similarity in the study design and participants among these 3 studies clarified that the main cause for the non-significant effect of glucomannan in the study by Keithy et al can be related to low dosage (1.3 g/d vs. minimum 6 g/d in the other studies). None of these studies reported dietary intake and the changes in food intake were unclear. Differences in type of fiber, baseline BMI and adherence to a low-calorie diet may result in more weight reduction using glucomannan compared to other studies. Mannans are classified as more soluble, more fermentable and more viscous fibers.[27] These physicochemical properties can play major roles in weight management. Glucomannan and gum Arabic seem to reduce body weight through promoting satiety sensation, delaying gastric emptying, and affect satiety hormones like other dietary fibers. They can also absorb water, expand in the gastrointestinal tract, and induce fullness feeling.[33,34] Leptin can simultaneously reduce energy intake and increase energy expenditure. Therefore, these types of fibers indirectly enhance energy expenditure and promote losing weight. Gum Arabic may also inhibit intestinal glucose absorption and blunt weight gain.[34] Apart from these proposed mechanisms, fibers including gum Arabic can bind to bile acids and diminish their absorption. Then, in the large intestine, gum Arabic degenerates and releases the bile acids. During the fermentation the acidic pH promotes their excretion. By these mechanisms, soluble fiber can reduce fat absorption. It seems that long term consumption of gum Arabic is helpful for weight loss.[34] Mannans are indigestible; however, they can be fermented in the colon and showed prebiotic effects. They produce SCFA and change bacteria flora. Through this pathway, they can regulate energy intake and body weight.[34]

Pectin-rich fibers are a kind of complex fiber. They are more soluble and more viscous.[27] In the present systematic review, only one study evaluated the effects of a kind of pectin-rich fiber, named lupin kernel fiber. Lupin kernel fibre is one of the legume components that have demonstrated beneficial effects on human health.[21] Fenchner et al reported positive effects of supplementation on anthropometric indices, body composition and energy intake. Similar to other mentioned fibers, it showed prebiotic effects and promoted human health.[21] The strength of this trial was related to the study design. It was a randomized cross-over study and each participant served as his or her own control. Therefore, the effects of confounding covariates could be reduced.

There was just one study that evaluated the effects of RS and alginate on weight management. Karimi et al did not report the efficacy of RS2 in weight management.[32] This kind of fiber is not viscose, fermentable or soluble.[27] Therefore, the negative results can be due to its physicochemical characteristics. However, George et al concluded that sodium alginate can promote weight loss.[43] As mentioned previously, water-holding capacity, solubility, fermentability and viscosity rates are associated with energy intake, hunger/fullness sensation and body weight. Since alginate is a more soluble and viscose fiber, positive effects on weight management were expected.

We found conflicting results in the effects of other fiber groups (fructan, β-glucan and psyllium) on body weight.[16,17,20,30,31,35–37,39] Dietary fibers, especially soluble fiber (pectin, psyllium, fructans etc), can bind water and effectively reduce energy density of a meal. Energy density is associated with higher weight change, adiposity and BMI. Therefore, reduction in dietary energy density can be helpful for weight management.[18] Soluble fibers can also increase gastric distension and sensations of fullness.[44] However, study design, dosage, duration of study, characteristics of participants, disease background and lifestyle can affect the results of studies.

The impacts of fiber supplements on body composition, WC and HC were assessed in limited clinical trials. Therefore, their efficacy on these parameters and main mechanisms remained unclear. We found that dextrin, glucomannan and lupin kernel reduced FM. Additionally, WC was decreased following supplementation with beta-glucan, glucomannan, lupin kernel and psyllium. Changes in HC were evaluated in one study[42] on PGX and positive effects were reported. Evidence showed that in addition to from reduction in body weight, fiber supplements might improve body composition and adiposity distribution. Reduction in hunger feeling and food intake, and changes in gut microbiota which are influenced by physiochemical characteristics of fiber are likely to be involved in improvement of these anthropometric indices.

Limitations and Strengths

Due to limited studies on each fiber group, quantitative synthesis regarding the effect of supplementation with fiber on body weight was not possible. Moreover, from the present evidence, it is not clear which dosage of each fiber supplement would be relatively effective for obesity management. However, the dosages used in the trials tended to be high (range of dosages with no other interventions was 6–25 g/d) for weight-loss in comparison to other anti-obesity supplements. The strengths of this systematic review are updating the literatures on each group of fiber supplements and in comparisons of their effects. Moreover, drawing a conclusion was performed after quality assessment of each paper. Including high quality papers can protect final conclusion against common biases.

In conclusion, the present systematic review revealed that the efficacy of various fiber supplements in losing weight, appetite, and energy intake is different. Physicochemical properties of fibers play a main role in their effects. Dextrin, mannan (gum Arabic) and pectin-rich fiber (lupin kernel), which are soluble and fermentable fibers, with no dietary interventions showed a reduction in body weight and energy intake. However, from the clinical point of view, their effects on body weight were not considerable. Many factors including physicochemical properties of fibers, dosages, treatment duration and participants' characteristics can be involved in these variations. Overall, the effects of fiber supplements with no other weight-loss interventions were not notable for obesity management. However, due to insufficient clinical trials on each type of fiber supplement, findings should be declared by caution. Additional research is needed on comparison of different fiber supplements in similar conditions to clarify which type and dosage of fiber supplement can be a good choice as a complementary therapy in obesity management.

Conflict of Interest Disclosures

The authors have no conflicts of interest.

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