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REVIEW ARTICLE

The Effects a Traditional Meal Pattern vs. Small Frequent Meals has on Body Composition in Overweight and Obese Adults: A Systematic Review

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Abstract

Objective: Globally, adult obesity continues to rise. An effective method to maintain weight loss is by consumption of small frequent meals. However, discrepancies exist within the literature about the number of meals that result in weight loss. Thus, this systematic review examined the effects of consuming a traditional meal pattern versus small frequent meals on body composition in overweight and obese adults.

Design and Methods: Articles were extracted from three databases: Academic Search Ultimate, PubMed, and CINAHL Plus using key words such as "isocaloric meals", "small frequent meals" and "adult overweight/obesity". A 9-point inclusion criteria that included: randomized controlled trials, overweight/obese adults aged 18 years and older, consumption of traditional and small frequent meals, and outcomes that included body composition (e.g. (BMI kg/m^2), body fat percentage, waist circumference) aided in extraction of articles. Data extraction and evaluation of the articles was assessed using the Academy of Nutrition and Dietetics Evidence Based Manual.

Results: A total of 1,486 articles were obtained. Six articles met the inclusion criteria. Over the short-term period, less than 12 months, results showed that regardless of the meals consumed (<5 or >5) adults had a significant reduction in their BMI and fat mass when participating in nutrition education and physical activity compared to adults who consumed >5 small-meals per day and did not participate in nutrition education and physical activity.

Conclusions: This systematic review provides evidence that individuals who consume small frequent meals with the combination of exercise and nutrition and/or behavioral education reduces overall body composition compared to individuals who did not participate in exercise or education regardless of the number of meals consumed.

Introduction

The global rise in obesity has deemed it a public health crisis as an estimated 603.7 million adults were considered obese in 2015. [1,2] This is a three-fold increase in obesity rates since the 1980s. [2] There are several factors that contribute to this rise in obesity such as poor dietary behaviors (e.g. large portion sizes and consumption of high fat/high sodium foods and low consumption of fruits, vegetables, and whole grains), chronic dieting with weight fluctuations, and sedentary behaviors. [3–5] Adults, who are overweight or obese, are more likely to experience chronic diseases and conditions such as pulmonary diseases (e.g. sleep apnea), type 2 diabetes, and heart disease. [3–8] To reduce one's risk for chronic diseases and conditions, weight loss is commonly recommended.

From the years 1999-2002, 57 percent of American women and 35 percent of American men attempted to lose weight via commercial weight loss programs (e.g. Atkins) and products (e.g. Herbalife). [9] In 2014, adults around the world spent $148.1 billion on these programs and products and that number is expected to rise to $206.4 billion by 2019. [10,11] In other words, an estimated $155 to $424 per month is spent on commercial weight loss programs such as Weight Watchers and Jenny Craig. [12] However, these programs and products commonly end in weight regain within one year, alluding to the fact that the effort and money used on these programs and products are rather ineffective. [3,13–17] Thus, lifestyle modifications may be a more effective method to reduce weight compared to these programs and products.

Lifestyle modifications, that incorporate both dietary such as reducing portion sizes, reducing consumption of high fat foods, consuming high fiber foods, and physical activity such as being active at least 150 minutes throughout the week, may help maintain healthy weight loss over the long-term. [3,5,9] A reduction of at least 10% body fat not only improves weight status, but also reduces the risk of developing chronic diseases and conditions. [6,16,18] Aside from the current recommendations to consume smaller portion sizes, reduce total fat and sodium, and consume more fruits, vegetables, and

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whole grains, [6,15,16] results from studies suggest that long-term weight loss can be maintained by consumption of small frequent meals (SFM) as compared to the traditional three meals per day. [19–25] SFM consist of consuming between five to seven small meals per day with similar caloric intakes at each meal (approximately 200 to 300 calories per meal). [25] SFM could potentially increase satiety and decrease hunger; thus, resulting in weight loss. [19–21] However, discrepancies exist within the literature regarding if SFM can lead to more significant reductions in body weight compared to the traditional meal pattern. [19,26] Therefore, the purpose of this systematic review was to examine the effects of consuming a traditional meal pattern (two to three small meals with or without snacks) versus small frequent meals (five to seven calorically balanced meals) on body composition in overweight and obese adults.

Methods

Review Search Strategy

The review was conducted by two independent researchers from Eastern Illinois University (EIU) using the Preferred Reporting Items for Systematic review and Meta-analysis (PRISMA). [27] Identification of studies followed a three step process: i) search, ii) distillation, and iii) independent review. To assess the quality of the identified studies, the researchers used the Academy of Nutrition and Dietetics (AND) Evidence Analysis Manual. [28] No IRB approval was acquired due to no humans or animals were involved in this study.

In the first phase, search, the researchers used three databases: Academic Search Ultimate, PubMed, and CINAHL Plus to identify articles. Search terms used to identify these articles were: "meal frequency", "eating frequency", "isocaloric meals", "small frequent meals", "weight loss", and "adult overweight/obesity". A language restriction was applied to include publications written in English. Also, a time restriction for literature published between January 1, 1997 – February 28, 2017 was applied. The reference list of the retrieved articles was searched to identify other relevant manuscripts for this review. Literature searches were combined into EPPI-Reviewer 4, [29] a software to assist in screening and removing duplicate articles.

Eligibility criteria

The second phase of the systematic review process was the distillation phase. This involved one researcher reading through the titles and abstracts to identify articles that met the following nine inclusion criteria: studies (1) were published in peer-reviewed journals, (2) were issued during 1997-2017, (3) used a randomly-controlled design, (4) included participants who were overweight and/or obese (body mass index (BMI) $\geq$ 25 kg/m^2), (5) included participants with no pre-exisiting conditions (e.g. metabolic syndrome, diabetes, cardiovascular disease), (6) included participants who were adults, 18 years or older, (7) included a control group that included 2 or 3 meals with or without snacks and an intervention group that consumed small meals (>5) at consistent calories and times throughout the day, (8) did not have meals that were comprised of liquid supplements, and (9) included outcomes of body composition (weight, BMI (kg/m^2), body fat percentage, and/or waist circumference).

Studies were excluded if (1) they were published prior to 1997, (2) the study design was not randomly controlled, (3) participants were not overweight or obese (BMI < 25 kg/m^2), (4) participants had a pre-existing condition (e.g. metabolic syndrome, diabetes, cardiovascular disease), (5) participants were under the age of 18 years, (6) the study did not focus on traditional eating and small frequent meals, (7) meals consisted of liquid supplements, (8) participants were pregnant or post-partum, (9) participants were receiving or had received gastric surgery or had an eating disorder, (10) participants were not human, and (11) outcomes did not include body composition (weight, BMI (kg/m^2), body fat percentage, and/or waist circumference).

The third phase of the systematic review process was the independent review of articles. In this phase, two independent researchers read all remaining articles to determine the ones that met the inclusion criteria. After each reviewer independently identified the articles to keep, if discrepancies existed, a discussion took place until reviewers were satisfied with including or excluding articles.

Data extraction

Table 1 was constructed and organized by the researchers to compare the data extracted from each article that was included in this systematic review. The data extracted included the first author's last name, publication date, participants' information (age and body mass category), design/intervention groups, number of meals and calories consumed per day, duration of study, evaluation measures, and outcome measures.

Critical evaluation of material

The methodological quality of each study was assessed using the AND Evidence Analysis Manual, which consisted of a Quality Criteria Checklist. [28] These systematic, unbiased methods consisted of two parts: relevance and validity. Relevance determines a study's usefulness to the nutrition profession and is defined by four questions. If responses to the four questions were yes, the reviewers then proceeded to the validation questions, otherwise the article was removed from this systematic review.

For validity, 10 criteria questions were used to determine the quality of these studies. A thorough discussion of each criterion is found within the AND Evidence Analysis Manual. [28] Each component within the validity portion of the analysis manual were answered with a yes, no, unclear, or not applicable. An article was determined high quality (+) if responses to validity criteria 2, 3, 6, and 7 were yes with an additional yes from another criterion. An article was determined low quality (-) and subsequently removed from further analysis if the responses to criteria 2, 3, 6, and 7 and two additional criteria were no. An article was determined neutral (Θ) if responses to the validity critera 2, 3, 6, and 7 were no or unclear.

Author (year)	Study Design, Location & Duration	Age & Number of Participants	BMIs (kg/m^2)	Intervention Description	Evaluation Measures	Findings
Alencar et al. (2015)[31]	-Randomized crossover design -USA -6 weeks	52 ± 7-years-old N=11	BMI: 39.1 ± 7.6	Randomized to 2 (every 5-6 hrs) or 6 (every 2-3 hrs) meals x 2 weeks; reverse for 2 weeks; PA[2]; NBE[3]	BMI[5], WHR[6], WC[7], % body fat & FFM[8]	-BMI[5], WHR[6], WC[7], % body fat decreased regardless of consuming 2 or 6 meals ($p<0.05$) -FFM[8] increased in those who consumed 6 meals ($p<0.05$)
Bachman & Raynor (2012)[24]	-Parallel-group RCT[1] -USA -6 months	51 ± 9.9-years-old Intervention: n= 22 Control: n=23	BMI: 35.5 ± 4.8	-Intervention: 5-6 low-calorie, low-fat meals -Control: 3 low-calorie, low-fat traditional meals -Both groups: PA[2], NBE[3]	BMI[5] & % body fat	BMI[5] & % body fat decreased in both groups ($p>0.05$)
Cameron et al. (2010)[32]	-Parallel-group RCT[1] -Canada -8 weeks	18 to 55-years-old Intervention: n=8 Control: n=8	Intervention BMI: 37.1 Control BMI: 34.8	-Intervention: 6 low-calorie meals -Control: 3 low-calorie traditional meals	BMI[5], LBM[9] & fat mass	BMI[5], LBM[9], fat mass decreased in both groups ($p<0.05$)
de la Iglesia et al. (2013)[33]	-RCT[1] -Spain -6 months	Adults (age not specified) Intervention: n=41 Control: n=43	Intervention BMI: 37.41 ± 0.8 Control BMI: 36.4 ± 0.7	-Intervention: 7 low-calorie, high-protein meals -Control: 3-5 low-calorie traditional meals -Both groups: PA[2], NBE[3]	BMI[5], WHR[6], WC[7], % body fat, FFM[8] & LBM[9]	-BMI[5], WHR[6], WC[7], % body fat, FFM[8], LBM[9], decreased in both groups ($p<0.05$) -Android fat mass decreased in intervention group ($p<0.05$)
Forslund et al. (2008)[34]	-Parallel-group RCT[1] -Sweden -12 months	18 to 60-years-old Intervention: n=44 Control: n=49	Intervention BMI: 39.4 ± 6.5 Control BMI: 38.8 ± 5.8	-Intervention: 6 low-calorie meals; -Control: 3 low-calorie traditional meals -Both groups: PA[2], NE[4]	Weight	Weight decreased in both groups, but not significant after 1 year
Zargaran et al. (2014)[35]	-RCT[1] -Iran -3 months	20 to 60-years-old Intervention: n=41 Control: n=43	Intervention BMI: 30.9 ± 5.1 Control BMI: 30.3 ± 4.7	-Intervention: 6 low-calorie meals -Control: 3 large meals & 2 snacks – low-calorie traditional meal pattern	BMI[5]	BMI[5] decreased in both groups ($p<0.05$)

Note. RCT[1] = Randomized Control Trial, PA[2]= Physical Activity, NBE[3]= Nutrition & Behavioral Education, NE[4]= Nutrition Education, BMI[5]= Body Mass Index, WHR[6]= Waist to Hip Ratio, WC[7]= Waist Circumference, FFM[8]= Fat Free Mass, LBM[9]= Lean Body Mass

Table 1: Summary of the Studies (n=6).

After the two independent reviewers evaluated the quality of the articles, inter-rater reliability was determined for the rater pair (JMA - LW) using quadratic weighted Cohen's kappa statistic. [30] A quadratic weighted Cohen's Kappa was selected to account for the degree of disagreement among raters. Kappa results were interpreted as follows: values ≤ 0 indicate no agreement, 0.01–0.20 indicate none to slight agreement, 0.21–0.40 indicate fair agreement, 0.41– 0.60 indicate moderate agreement, 0.61–0.80 indicate substantial agreement, and 0.81–1.00 indicate almost perfect agreement. [30]

Results

Included studies

A total of 1,486 articles were identified in the first search phase: Academic Search Ultimate (n=418), PubMed (n=777), and CINAHL Plus (n=291). After removal of duplicate articles, 832 articles remained. After the second phase, distillation, articles were removed if studies were not written in English (n=5), were not randomly controlled trials (n=50), did not include participants who were overweight or obese (n=21), did not include participants who were 18 years of age or older (n=193), study did not compare traditional meals with small frequent meals (n=415), participants had a pre-existing condition (n=11), participants were pregnant and/or post-partum (n=12), included participants who were receiving or had received GI surgery or had an eating disorder (n=58), participants were not humans (n=15), and outcomes did not include body composition (n=23). This distillation phase yielded 34 articles for further review. After two independent researchers read these articles, they met to discuss the inclusion and exclusion of articles. The researchers agreed that 23 articles should be dropped as these were not randomly controlled trials (n=12), the small frequent meals consisted of liquid supplements (n=1), participants included had a BMI < 25 kg/m^2 (n=7), and the outcomes did not include body composition (n=3). Thus, a total of 11 articles remained. Five articles were discussed fully as there were disagreements among the researchers. After discussion, those five articles were dropped due to two main reasons: i) outcomes were not focused on body composition (n=2) and ii) intervention did not include small frequent meals (n=3). Therefore, a total of six articles remained for critical appraisal (Figure 1).

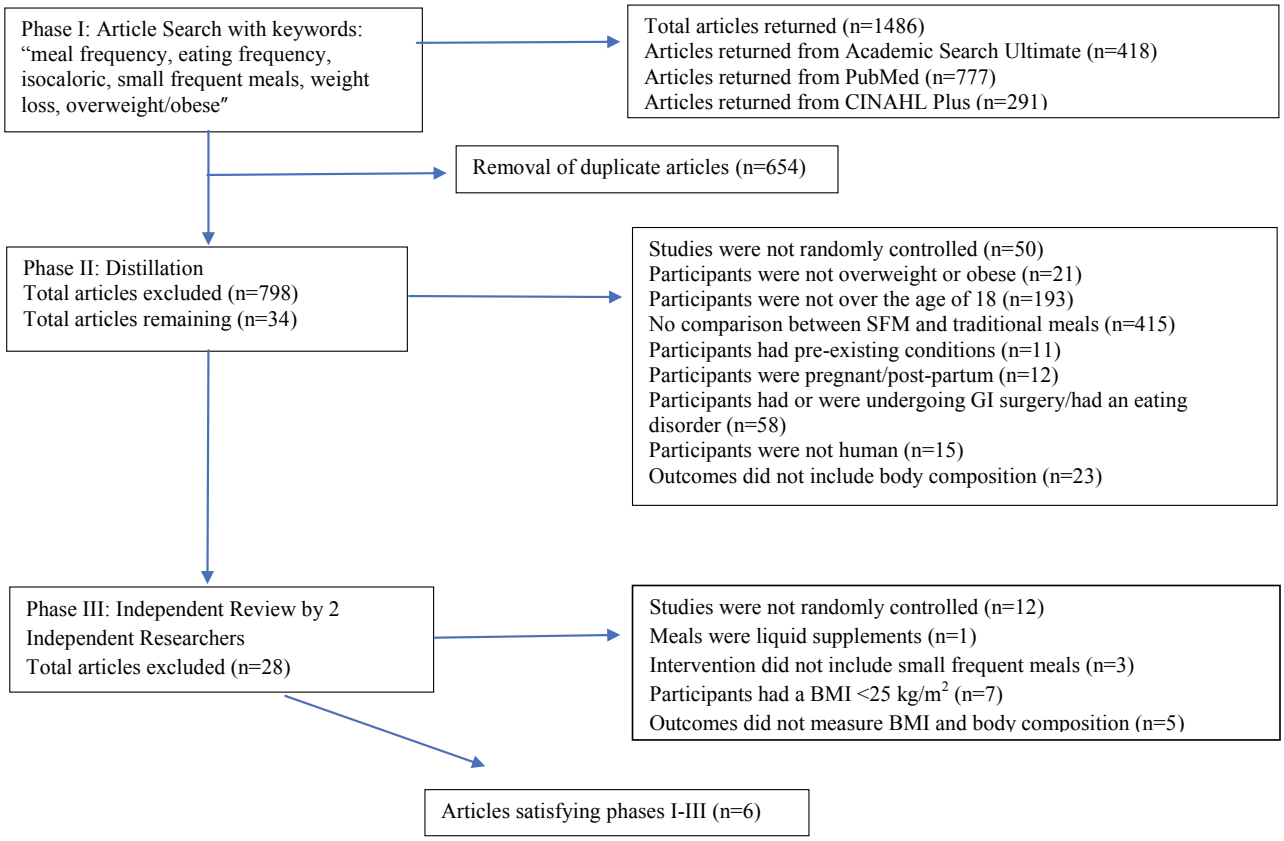

Figure 1: critical appraisal.

Study characteristics

Table 1 lists characteristics of the studies included in this systematic review. The six studies included a total of 333 participants aged 18 years or older, with the average age of 34 years old. The gender of the participants was mainly female (60%). The individual study sizes ranged from 11 to 93 participants. The BMI (kg/m^2) was above 30 kg/m^2 for all six studies, [21,31–35] which indicates participants were obese. Two of the studies were randomized controlled trials, [33,35] three of the studies were parallel group randomized controlled trials, [21,32,34] while Alencar and colleagues [31] used a randomized crossover design. Two studies were conducted in the United States, [21,31] one in Spain, [33] one in Iran, [35] one in Canada, [32] and one in Sweden. [34] The duration of the interventions were six weeks, [31] eight weeks, [32] three months, [35] six months, [21,33] and 12 months. [34]

Synthesis of results

Of the six studies reviewed, a common objective was to determine the impact meal frequency had on body composition. Participants in the control groups consumed either three meals per day [21,32,34] or three meals and two snacks per day. [33,35] Participants in the intervention groups consumed six small meals that were comprised of equivalent restricted calories (e.g. 200-300 calories per meal) [21,32,34,35] or 7 small meals per day that were comprised of equivalent calories. [33] In the study by Alencar and colleagues, [31] participants were randomized to either consuming 2 meals or 6 meals per day for two weeks and then reversed for two weeks. Two studies [31,33] distributed macronutrients based on the Acceptable Macronutrient Distribution Ranges (AMDR).

Along with meal frequency and energy restriction, four studies incorporated physical activity to encourage weight loss. [21,31,33,34] Participants in both the intervention and control groups improved in their physical activity, whether decreasing their sedentary activities (e.g. sitting for long periods of time), [33,34] or increasing their moderate intensity activity to 30 minutes per day, [31] or being active for at least 200 minutes per week. [21] Additionally, three studies provided nutrition and behavioral education to participants in both control and intervention groups throughout the length of the study period. [21,31,34]

Results from five studies showed modest, but not significant decreases in weight/BMI among the intervention groups compared to the control groups. [21,31-33,35] Results from one study reported weight loss in the intervention group compared to the control group, but significance levels were not identified. [34] Additionally, results from the studies that measured body fat showed significant declines in both intervention and control groups compared to baseline. [21,31–33] Results from Fat Free Mass (FFM) measurements were inconsistent. In one study, results showed a significant increase in FFM for participants who were in the intervention group [33] whereas two studies showed a significant decline in FFM for both intervention and control groups. [31,32]

Author (Year)	Quality rating	Research question stated	Clear of selection bias	Comparable study groups	Withdraws discussed	Blinding use	Intervention described	Outcomes defined	Appropriate statistical analyses	Results support conclusions	No potential for funding bias
Alencar et al. (2015)[31]	+	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bachman & Raynor (2012)[24]	+	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes
Cameron et al. (2010)[32]	+	Yes	No	Yes	Unclear	Yes	Unclear	Yes	Yes	Yes	Yes
de la Iglesia et al. (2013)[33]	+	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Yes
Forslund et al. (2008)[34]	+	Yes	Unclear	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes
Zargaran et al. (2014)[35]	+	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes

Note. Quality ratings: (+) = positive

Table 2: Quality of Studies within the Systematic Review (n=6).

Table 2 summarizes the quality rating of the studies based on the AND Evidence Based Analysis Manual [28] and the collective agreement among the two researchers. All six studies were considered high-quality as more than six out of the ten validation questions had a response of yes. The most common factors that impacted the effectiveness of the studies were limited adjustments in statistical analyses for withdrawals, limited explanation of withdrawals, unbiased endpoint assessment (i.e. not clearly stating if the participants were blinded), calculation of outside factors that could impact the results (i.e. under or over reporting food consumption in the home and maximum rate of exercising), and short study duration (i.e. six weeks) that may impact body composition. The overall Kappa scores from the pair JMA- LW was 0.65, which demonstrates substantial agreement among the pair.

Discussion

A total of six studies were included in this systematic review to examine the effects of consuming a traditional meal pattern versus SFM on body composition in overweight and obese adults. The findings of this review indicate that consuming SFM, at least over the short-term (e.g. 12 months or less), may improve overweight and obese individuals' body compositions. However, the body composition results from the studies were not statistically significant between individuals who consumed SFM compared to individuals who consumed a traditional meal pattern. In other words, weight loss occurred in both groups. Additionally, the studies that included physical activity [21,31,33,34] and nutrition [34] and behavioral education [21,31,33] throughout the intervention periods resulted in a greater improvement among overweight and obese individuals' body compositions compared to studies that only had their participants consume SFM.

Similar results to this systematic review were discovered in Salehi and colleagues' [36] study. The researchers provided six SFM meals with consistent calories to participants in the intervention group and provided three meals and two snacks to the control group. The results indicated that weight decreased in both the intervention and control groups, but only the intervention group was statistically significant compared to the baseline data. Furthermore, Feller and colleagues [37] used a survey to compare the eating habits between successful weight loss maintainers and the general population in Germany. Results demonstrated that successful weight-loss maintainers consumed a minimum of three meals per day that were low in calories and fat compared to those of the general population. Additionally, those who were weight-loss maintainers exercised at minimum 30 minutes per day two to three days per week compared to the general population. Zhu and Hollis [38] also looked at the effects of eating frequency on weight and diet quality among nearly 8000 men and women with an average BMI of 28 kg/m^2. Results showed that individuals who consumed more meals per day (e.g. >4), consumed lower, energy dense meals, and a more nutritious diet (high fiber, low total fat, and low sodium) had lower body compositions compared to individuals who consumed less meals per day (e.g. <3) and consumed less nutritious foods (high in saturated fats and sodium). On the other hand, a literature review by Kant [39] concluded that individuals, in all BMI categories, who consumed SFM did not reduce weight compared to individuals who consumed a traditional meal pattern.

There are a few mechanisms that promote weight loss and maintenance when consuming SFM. Jackson and colleagues [40] suggested that SFM delays gastric emptying, leading to increased satiety and decreased hunger. Delayed gastric emptying possibly occurs with higher exposure to food in the gut, which causes quicker feelings of fullness for an extended period. When consuming SFM, especially with meals that contain proteins and fats, cholecystokinin (CCK) is released at a higher rate compared to consuming a traditional meal, thus signals to eat are delayed. [41,42] Allirot and colleagues [43] also argue that SFM can decrease appetite in the short term (roughly four hours) as ghrelin levels may be lower with higher GLP-1 levels.

SFM that contain higher amounts of protein, roughly 25 percent of calories, may increase satiation and thus decrease energy intake due to increased plasma leucine. Leucine stimulates muscle protein synthesis and increases fat oxidation, which results in reduction of fat mass. [44–46] Furthermore, Arciero and colleagues [20] suggest that body composition

may be improved with frequent, higher protein meals as a result of increased postprandial thermogenesis. Moreover, a systematic review conducted by Leidy and Campbell, [44] suggests that consuming more meals throughout the day may reduce the overall caloric intake and thus promote weight loss. However, this requires proper portion control and limiting the consumption of energy-dense foods (such as sugar sweetened beverages and high saturated fat/sodium foods) to see weight loss effects. [36,47–49] On the other hand, Mills, Perry, and Reicks [50] challenged the argument that high meal frequency (on average five meals per day) can lead to a reduced caloric intake. In their study, they surveyed 1099 women, with an average BMI of 27.7 kg/m^2. Results indicated there was no relationship between eating frequency and BMI status. However, obese females who consumed four or more meals per day consumed higher energy amounts compared to normal weight females who consumed the same amount of meals per day. Moreover, reduced energy intake when consuming SFM may be attributed more to the macronutrient distribution of each meal rather than total calories at each meal.

As mentioned in the results, nutrition and behavioral education [21,31,34], physical activity, [21,31,33,34] and energy-restricted meals [21,31–35] were included in both intervention and control groups, which may have influenced the outcomes. Another systematic review that sought to identify the factors associated with weight loss maintenance and weight regain noted that a physically active lifestyle, self-monitoring behaviors, coping strategies, and support were all associated with weight loss maintainers. [51] It is the position of the Academy of Nutrition and Dietetics [16] that physical activity alone may not produce significant weight loss effects, but when paired with an appropriate dietary intervention (such as SFM), it seems to improve weight loss results. This position can be compared to another systematic review which provided evidence that adding physical activity to one's routine is important to successful weight loss maintenance. [52] This same study also noted that successful weight loss maintainers engage in using behavioral modifications, such as self-monitoring, to be successful. [52] In a similar way, Appel and colleagues [53] found evidence suggesting that behavioral interventions (one without face-to-face contact and one with in-person support) led to clinically significant weight loss.

Additionally, nutrition education may promote weight loss results in combination with consuming SFM. For instance, overweight and obese low-income mothers, who attended weight loss classes that combined nutrition education and promotion of physical activity, resulted in more weight loss than those who did not attend these classes. [54] Lastly, consuming less calories while expending more calories will result in weight loss. [4,6] All six studies had the intervention groups consume SFM that were calorie-restricted, which may have enhanced weight loss. Therefore, overweight and obese individuals may need to consume SFM that are calorie restricted, incorporate physical activity at a minimum of 150 minutes per week, and receive nutrition and behavioral education to enhance their weight loss effects.

Limitations

A limitation of this study was the inability to compare effect sizes due to inconsistent study lengths and methodologies. Thus, this discussion highlighted SFM interventions that were able to demonstrate improvements with statistical significance in BMI and body composition against a control group. A second limitation was the primary focus on frequency of meal consumption and the outcome of body composition. Continuous improvements in the quality of diets and physical activity, for example, can positively influence obesity-related outcomes. A third limitation was the initial starting BMI (kg/m^2) of all participants. The baseline data of all studies focused on the average BMI of the participants. Thus, skewing the effectiveness of the programs since adults who have higher BMIs may reduce their BMIs at a different rate than adults who have lower BMIs.

Strengths

Despite the limitations, this systematic review included studies which showed overweight and obese individuals who consumed SFM subsequently improved their body composition, at least in the short term. Additionally, results showed that by incorporating physical activity and nutrition and behavioral education, participants improved their body composition more so than individuals who only consumed SFM. Therefore, SFM in combination with physical activity and nutrition and behavioral education may be the best option for long-term weight loss and maintenance.

Implications for future research and health professionals

Due to limited research regarding the long-term effectiveness of SFM, future research should seek to identify the long-term effects (>12 months) of SFM, including its ability to be maintained over a period and its effects on weight and obesity-related diseases. While it is said that the body can adapt to a higher meal frequency to decrease total caloric intake when compared to the traditional meal pattern, [18,55] it was not demonstrated in the studies included in this review. As a result, future studies should limit dietary guidelines for caloric and macronutrient consumption while following SFM to determine if SFM have the potential to aid in decreasing daily caloric intake. Additionally, since SFM have the potential to aid in weight loss in some individuals, it could be recommended by health professionals. However, it should be noted that the effects may not be much different than that of the traditional meal pattern. More research about the effects of SFM on weight loss is needed to determine the true long-term benefits of this meal pattern and its effectiveness as a treatment option for obesity.

Conclusion

Since obesity remains an issue despite many attempts to decrease its prevalence, effective interventions are needed to promote weight loss and improve the health of overweight and obese adults. Numerous weight loss attempts have resulted in short-term benefits only, leading to the need for long-term

solutions. SFM may aid in weight loss for overweight and obese adults, although the long-term effects remain unclear. SFM may be an acceptable treatment option for obesity, however, it is imperative that more research is conducted to determine its ability to promote weight loss and maintenance over a long period.

Conflict of interest statement

The authors declare no conflict of interest.

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