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Research Article

Dietary Patterns and Healthy Eating Scores of Breastfeeding Mothers

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Abstract

Obesity in America has risen to epidemic levels over the past 10-years. Retention of weight gained during pregnancy may be a contributing factor. Breastfeeding may reduce long-term maternal weight retention from pregnancy and is recommended for at least the first six months. The study's purpose was to assess the effects of a 12-week nutrition and exercise program on dietary patterns and diet quality using the Healthy Eating Index (HEI) in lactating women. The participants were from the MEEMA (Moms Exercising and Eating for Maintaining Health and Active Lifestyle) study. Eligible women completed baseline and endpoint three-day diet interviews recorded on the Nutrition Data System for Research (NDSR 2019, UMinn.). Participants randomized into the intervention group (IG, n = 6) underwent 12-weeks of exercise, nutrition education and were given 6-oz of yogurt 3-times/week. IG increased their fruit intake (1.1 to 1.8 servings), vegetable intake (3.3 to 4.4 servings), and total grains (1.8 to 7.8 servings) to meet the recommended servings. Dairy intake remained unchanged and below the recommendation of 3 servings/day. The dietary quality measured using HEI scores for the women declined (59.8 ± 6.4 to 54.3 ± 11.2 out of 100) due to reduced whole grain intake. Overall, IG increased consumption of fruits, vegetables, and grains; decreased consumption of sweets and protein intake to meet recommendations. The findings suggest that exercise, nutrition education, and yogurt consumption may improve dietary patterns of lactating women. However, more tailored nutrition education is needed to improve dietary patterns and dietary quality using HEI scores.

Keywords: Diet Quality; Diet Patterns; Healthy Eating Index; Breastfeeding

Abbreviations

BMI: Body Mass Index; CG: Control Group; HEI: Healthy Eating Index; IG: Intervention Group; IRB: Institutional Review Board; MEEMA: Moms Exercising and Eating for Maintaining Health and Active Lifestyle; NDSR: Nutrition Data System for Research; PPWR: Postpartum Weight Retention

Introduction

Rising obesity levels in the United States is a cause of concern and the onset of motherhood is associated with increased body mass index (BMI) and decreased physical activity [1]. At one year postpartum, about 50% of women retain 10 pounds, while nearly 25% retain 20 pounds or more [2]. Attenuating postpartum weight retention (PPWR) in women may be an effective way to address

obesity in these breastfeeding women. PPWR may be particularly harmful as body fat gained during this period tends to accumulate at the waist, which has a greater association for disease risk than weight gain in other parts of the body [3]. Therefore, it is imperative to identify practical strategies to help women reduce PPWR and manage healthy lifestyle behaviors.

Breastfeeding [4,5], regular exercise [4], and diet [4,6] are a few modifiable lifestyle factors that may help reduce PPWR. The recommendation is for women to breastfeed exclusively for six months postpartum [2,7] and are encouraged to continue at least up to a year postpartum [7]. Postpartum women have the same exercise recommendations as adults: 150 minutes of moderate to intense aerobic activity at least two days per week [8]. Lactating women have dietary recommendations similar to non-lactating, non-pregnant women, though caloric needs are increased to support breastfeeding [2]. Studies have shown that interventions as short as four weeks can have a significant influence on health-promoting lifestyle-behaviors [9].

Limited studies have examined the combined effect of breastfeeding, exercise, and nutrition education [10-13] on diet patterns and diet quality of postpartum women. Therefore, the purpose was to assess the effects of a 12-week nutrition and exercise program on the dietary patterns and dietary quality of participants enrolled in the Moms Eating and Exercising for Maintaining Health and Active Lifestyle (MEEMA) study [14].

Materials and Methods

Study design

Recruitment

Participants in this investigation were part of the MEEMA study, which examined yogurt supplementation and exercise on body composition in lactating women from 8 - 20 weeks postpartum [14]. Eligibility criteria included fully lactating women, 25 to 40 years of age, full-term pregnancy (> 36 weeks), had a cesarean or vaginal singleton birth, and self-reported BMI within the range of 22 - 35 kg/m^2. Additionally, they must be sedentary for the past three months, medically cleared to exercise, and agree to randomization into the IG or CG. Exclusion criteria were diagnosis of a medical condition that affected hormones or exercise-contradicted medical complications, smokers, and formula feeding of infants (> 4 oz. given on occasion). Eligible participants were enrolled 4 - 8 weeks postpartum.

Recruitment was conducted in person or through flyers in local hospitals, pregnancy clinics, breastfeeding support groups, libraries, prenatal yoga classes and obstetricians' offices. Social media outlets such as Facebook advertised to local mom's support groups. Interested participants contacted research staff via email or telephone to determine eligibility. Researchers obtained a signed informed consent by eligible participants before baseline measurements and randomization.

Randomization

The study was a randomized intervention, stratified by parity into the intervention group (IG) or control group (CG) after completing baseline measurements. The IG underwent a three-days per week, 12-week community-based group exercise program and dietary intervention. Exercise sessions led by trained research assistants lasted for 45 to 60 minutes and consisted of exercises to stress and strengthen the bone and core muscles. Women were provided an individualized Omron Alvita pedometer calibrated by research assistants, encouraged to walk 10,000 steps per day, and self-reported any additional daily exercise outside the study's exercise sessions when asked at the start of each intervention week. The dietary intervention involved providing six-ounces of participants' choice of plain or vanilla yogurt fortified with vitamin D daily after each workout (3 times per week) during the 12-week intervention. Yogurt provided 250 mg of calcium [25% DRI, 1000 mg [15]], 8g of protein and less than 110 calories.

Additionally, weekly nutrition education sessions were provided one-on-one by a Registered Dietitian after the workout. Nutrition education covered different topics (e.g. label reading, healthy weight loss, and MyPlate) each week focused on lactating women and children. Research assistants recorded the participant's self-reported additional daily dairy intake during weekly exercise sessions by asking amount and type of dairy product consumed each day.

The CG participants were asked not to participate in any structured exercise or make any changes to their usual diet. After endpoint measurements, researchers provided the control group with all intervention material, including the community-based exercise program, Omron Alvita pedometer, individual dietary recommendations, and nutrition education topics.

Ethics statement

The Institutional Review Board (IRB) at North Carolina Agricultural and Technical State University approved this study (IRB#: 18-0010) and registered with ClinicalTrials.gov (NCT03732261).

Measurements

Laboratory measurements

Measurements at baseline (7 ± 2 weeks postpartum) and endpoint (19 ± 2 weeks postpartum) included demographics, anthropometric data and maternal dietary intake. Details of laboratory measurements are published elsewhere [14].

Dietary recalls

Assessment of dietary intake by three 24-hour dietary recalls completed for three days using the Nutrition Data System for Research (NDSR 2019, University of Minnesota) via telephone or in-person interviews during baseline and endpoint measurements. This method is accurate and validated in previous research studies against doubly-labeled water for assessing dietary intake in groups [16,17]. This system utilizes a 24-hour dietary recall automated multiple-pass method. A single 24-hour recall is an inexpensive way to record detailed information for all intake in the past recent 24-hours. However, many individuals tend to either under-or over-report as it relies on the participant's memory. Participants were provided a food amounts booklet for use during each 24-hour dietary recall interview to ensure the accuracy of measurement for reporting in the system. All attempts were made to collect dietary recalls within the same week and to include at least one weekend day. All dietary recall dates were obtained within one week of laboratory measurements.

Food groups

The Minnesota Nutrition Data System for Research categorizes food into nine major food groups: fruit; vegetables; grains; meat, fish, poultry, eggs, nuts, seeds and meat alternatives (protein); dairy and non-dairy alternatives (dairy), fats, extras (i.e., sweets, beverages and miscellaneous). The nine food groups are further divided into 174 subgroups (NDSR food groups). The subgroups for the fruit group included servings of whole fruit, excluding juices. The vegetable group included servings of dark green and orange vegetables. The subgroups for total grains used were whole grains, snack grains (e.g. crackers, popcorn, snack bars, and chips), and grain-based desserts (e.g. cakes, cookies, pastries, doughnuts, pies, and cobblers). Servings of frozen dairy desserts and nondairy alternatives (e.g. ice cream) were reported to compare the amount of ice cream consumed versus yogurt. The extra food groups include sweets (e.g. syrup, honey, jams, jellies, candy and sweet sauces), beverages (e.g. sweetened fruit drinks, soft drinks, and sweetened tea) and miscellaneous (e.g. non-sweet sauces and condiments, pickled foods, soup broth, and sugar substitutes).

Dietary quality using the healthy eating index

The Healthy Eating Index (HEI-2015) was developed by the United States Department of Agriculture and the National Cancer Institute to evaluate and score from 0 to 100 diets in their consistency with the Dietary Guidelines for Americans. The higher the scores (e.g., closer to 100), the higher the dietary quality with respect to the 2015-2020 dietary guidelines recommendations [18]. NDSR (UMinn, 2019) developed the SAS code used in this study to calculate HEI-2015 scores for each participant's three-day dietary intake.

Results

Participant demographics

Results and discussion must illustrate and interpret the reliable results of the study. Nineteen women were eligible for participation in the MEEMA study before discontinuing the study in March 2020 due to COVID-19. Six participants were randomized into the intervention arm of the study. Four of those participants completed all endpoint measurements of the 12-week intervention. Two of the six participants, at weeks 8 and 10 of the intervention at the time of the COVID-19 shutdown, only dietary data was captured. Full study results including the control group, have been previously published [14].

	Intervention Group (n = 6)	
	Baseline (n = 6)	Endpoint (n = 6)
	Mean (SD)	
Age (years)	35.2 (3.1)	36.2 (2.5)
Pre-pregnancy BMI (kg/m^2)	22.4 (1.5)	
Race		
Asian	1	
African American	1	
Caucasian	4	
Work Status		
Stay-at-Home Mom	2	
Work from Home	1	
Work away from Home	3	
Parity		
Primiparous	1	
Multiparous	5	
Anthropometrics	Baseline (n = 6)	Endpoint (n = 2)[1]
Weight (kg)	73.6 (9.3)	71.2 (14.9)
BMI (kg/m^2)	27.7 (2.6)	26.8 (3.4)
Dietary Intake	Baseline (n = 6)	Endpoint (n = 4)[1]
Energy Intake (kcal)	2255 (459)	2465 (541)
Energy Intake (kcal/kg)	30.9 (6.1)	33.1 (11.9)
Fiber (g)	22 (6)	25 (8)
Saturated Fat (g)	36 (13)	39 (11)
%Energy from Carbohydrates	37 (8)	41 (3)
%Energy from Protein	16 (3)	16 (3)
%Energy from Fat	39 (10)	39 (5)
% Energy from Sat Fat	36 (13)	39 (11)

Table 1: Participant characteristics for the intervention arm of the MEEMA study[1].

[1]COVID-19 social distancing orders limited collection of endpoint data. Anthropometric data could not be collected for two participants after the 12-week intervention.

Dietary patterns

At baseline, the intervention group met recommended servings of Vegetables but did not meet recommended servings of Fruit, Total Grains, and Total Dairy. Average Protein servings consumed exceeded recommendations. At the endpoint, the number of servings for Total Fruit, Whole Fruit, and Dark Green and Deep Yellow Vegetables improved. Additionally, servings of Snack Grains and Sweets decreased. Protein servings still exceeded recommendations but decreased since baseline and closer to recommended amounts. However, recommended Fruit and Total Dairy servings were still not met, Whole Grain servings decreased, and the number of Dessert Grains, Fats and Oils, and Alcohol servings increased at the endpoint.

Food Group	Recommended Servings[1]	Intervention Group (n = 6)	
		Baseline	Endpoint
		Scores listed as mean (SD)	
Fruit	2 - cup equivalent	1.1 (0.7)	1.8 (1.0)
Whole Fruit		0.9 (0.5)	1.4 (0.8)
Vegetables	3 - cup equivalent	3.3 (1.3)	4.4 (2.1)
Dark Green and Deep Yellow		1.0 (0.9)	1.5 (1.1)
Total Grains	7 - 8 ounce equivalent	1.8 (0.6)	7.8 (1.9)
Whole Grains		1.5 (0.7)	1.0 (0.8)
Snack Grains		1.6 (1.1)	1.1 (1.2)
Dessert Grains		0.4 (0.2)	1.0 (1.4)
Proteins	6 - 6.5 ounce equivalent	9.0 (3.1)	7.1 (3.3)
Total Dairy	3 - cup equivalent	1.6 (1.3)	1.6 (0.7)
Yogurt		0.0 (0.0)	0.3 (0.2)
Frozen Dairy Desserts		0.0 (0.1)	0.0 (0.0)
Fats and Oils		4.3 (2.5)	6.4 (4.1)
Sweets		1.7 (0.8)	0.9 (0.7)
Beverages		7.1 (4.5)	8.2 (3.7)
Alcohol		0.6 (1.3)	1.3 (1.8)
Miscellaneous		1.8 (2.8)	1.5 (0.9)

Table 2: Dietary patterns of the MEEMA study intervention group.

[1]Recommended servings were based on MyPlate Plan using mean age of participants – 34; breastfeeding only, no formula; height = 61.79 cm; weight baseline average 73.6 kg; physical activity <30 min/day of moderate activity.

Dietary quality measured using the healthy eating index (HEI) scores

Throughout the study, the intervention group's dietary quality decreased from an average total HEI score of 59.8 to 54.3. Additionally, whole grains, total protein and seafood and plant protein HEI scores declined. However, sub-scores for total vegetables in beans and greens, total fruit with whole fruit and added sugar improved.

Intervention Group (n = 6)			
Food Group	**Max Score**	**Baseline**	**Endpoint**
		Scores listed as mean (standard deviation)	
Total Score	100	59.8 (6.4)	54.3 (11.2)
Total Vegetables	5	3.3 (1.0)	3.9 (1.2)
Beans and Greens	5	3.9 (1.8)	4.5 (0.9)
Total Fruit	5	1.6 (1.0)	2.3 (1.4)
Whole Fruit	5	2.6 (1.6)	3.1 (1.6)
Grains Whole Grains	10	6.3 (2.7)	2.7 (2.2)
Refined Grains	10	6.1 (3.6)	4.9 (3.5)
Added Sugars	10	9.1 (1.6)	9.2 (1.4)
Dairy	10	5.3 (3.7)	5.3 (2.4)
Total Protein	5	5.0 (0.0)	4.6 (0.9)
Seafood and Plant	5	4.1 (2.0)	3.9 (2.0)
Fatty Acids	10	4.2 (3.6)	3.2 (2.4)
Saturated Fats	10	3.4 (3.5)	3.0 (1.7)
Sodium	10	4.8 (4.2)	3.7 (3.1)

Table 3: Dietary quality of the MEEMA study intervention group using HEI.

Discussion

Only six other studies with exercise, diet, or exercise and diet interventions analyzing postpartum dietary patterns, dietary quality, or both [10-13,19,20]. Of those studies, four included breastfeeding women in their study sample [10-13]; only one study examined fully-breastfeeding women [12]. Though the sample size of this study was small, these findings contribute to the body of research on the effects of diet and exercise on exclusively breastfeeding mothers.

This study found that fully-breastfeeding mothers participating in a community exercise and nutrition education program improved their dietary pattern with fruit, vegetables, snack grains, and sweets. However, the participant's overall diet quality during the 12-week intervention decreased despite observed improvements in amounts and quality of fruits and vegetables consumed. Results for grains are mixed. Whole-grain consumption decreased while refined grains such as dessert grain consumption increased. However, snack grain and sweets consumption deceased and added sugars HEI scores improved. There may have been an improvement in yogurt consumption, but the overall dairy intake and quality remained the same throughout the study. The number of protein servings and protein quality decreased, but this reduction brought consumption closer to recommended amounts. Despite some improvement in dietary patterns and decreased overall diet quality, participants in this study improved their BMI, lost body fat, and increased their lean body mass.

Dietary patterns

Though participants in this study did not meet recommended servings for fruit, they exceeded the average intake of lactating women and increased consumption to amounts closer to recommendations. Coupled with the improved Total Fruit HEI score, the nutrition education in this study had some impact. Additionally, the IG's Total Fruit and Whole Fruit HEI scores were similar to those of studies with postpartum, mostly breastfeeding women who received nutrition education [11] and postpartum women enrolled in an exercise support group [19].

Participants in this study not only met the vegetable servings recommendation, but they also exceeded the average intake of lactating women [2], as shown in the number of servings and HEI scores for total vegetables and their subgroups. Though self-reported diet recalls may be subject to over-reporting, other exercise studies found similar dietary patterns with postpartum women [11,20]. Conversely, one intervention study aimed at improving breastfeeding women's diet found no change in Vegetable HEI scores [13].

At baseline, consumption of grains was well below recommended servings and average intake of grains for lactating women. After the 12-week intervention, grain intakes were comparable to the average intake of lactating women and closer to meeting recommendations [2]. Despite being closer to meeting recommendations, a similar study reported a decrease in whole-grain servings with lactating women [13]. However, this study observed higher whole grain servings and HEI scores than other studies of postpartum women who underwent exercise and nutrition education [10,11]. Additionally, the participants in this study increased their intake of sweets and dessert grains, which may account for the decreased HEI score for whole grains. Similarly, a previous study found that extra calories in lactating women's diet came from desserts and refined grains [21]. The increase in dessert grains may have displaced snack grain consumption, as snack grain servings decreased throughout the 12-week intervention.

Nationally the average lactating women exceed protein intake recommendations [2], a pattern also seen in this study. Though intake was still below recommended servings, participants in this study consumed similar amounts of dairy servings as the national average lactating women [2]. Other studies have observed dairy consumption below recommendations [12,20,21]; and found similar dairy HEI scores [11,13,20]. Women in this study were provided yogurt by the research assistants after each of their workouts during the 12-week intervention. Despite the provision of yogurt after workout sessions and education on the benefits of dairy, endpoint dietary recalls revealed a small increase in yogurt or dairy servings. Additionally, total servings of dairy did not increase nor did dairy quality improve. Lack of improvements in dairy servings may have resulted from the discontinuation of workouts, and thus yogurt provisions, due to COVID-19 restrictions.

A reduction in sweet servings observed in this study's participants as well as in a similar exercise study with breastfeeding women [12]. Additionally, the Added Sugars HEI had a small improvement in its score. One study found that decreased sugar intake was a predictor of increased vegetable intake [22]. Though this study found improvements in Added Sugar HEI score and decreased Sweets servings, servings of dessert grains increased. Further research is necessary to understand the relationship between sweet consumption and diet/exercise in breastfeeding women.

Dietary quality measured using the healthy eating index (HEI) scores

Participants in this study had HEI scores higher than the national average for childbearing age women despite being lower than the national average for lactating women. A few comparable studies found similar total HEI scores for lactating women undergoing interventions including exercise, nutrition education or both [11,19]. It has been previously observed that diet quality may improve during pregnancy but decrease over time [2,23,24]. A meta-analysis review concluded the onset of parenthood might not change overall diet quality or that changes in diet patterns are mixed [25]. The lack of improvement in dietary patterns or quality might be attributed to a demand for time and resources from children, the potential economic situation changes, and other responsibilities [25]. Five of the participants in this study had more than one child to care for and three worked out of the home, explaining why more significant dietary improvements were not achieved despite nutrition education.

Furthermore, intervention modification and early discontinuation of the study due to COVID-19 restrictions may have influenced diet patterns. Resulting stay-at-home orders and financial difficulties may have independently affected dietary patterns of this population. Emerging studies have documented perceived weight gain, increases in BMI, and altered diet and exercising habits since stay-at-home orders were enacted [26,27].

Weight loss and PPWR

Despite decreases in diet quality scores, participants in this study lost an average of 1.9 kgs. Diet quantity may be more important to weight loss and reducing PPWR than quality [6,24,28]. Though average caloric intake from baseline to endpoint increased [14], weight loss seen in this study may have resulted from the difference between estimated increased caloric needs for breastfeeding and actual intake. However, maternal diet quality may be easier to modify than quantity [4]; and maternal diet quality can influence children's nutrition through breastmilk composition [29,30]

and children's eating patterns [31,32]. Therefore, additional research should identify successful strategies in improving overall maternal diet quality.

Conclusion

These results suggest that the 12-week yogurt and exercise intervention may have effectively improved servings of whole fruit, dark green vegetables, and yogurt in breastfeeding exercising mothers. Nonetheless, these changes did not change the overall diet quality of this population, potentially due to the small sample size. These findings contribute to the body of research on dietary patterns and diet quality of breastfeeding exercising women. Additional research characterizing diet patterns and quality in breastfeeding exercising women is warranted to determine the best strategies in improving health outcomes for mothers and their children.

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Conflict of Interest

The authors declare no conflict of interest.

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