RESEARCH PAPER

Milk Production and Body Weight Response to Suggested Protocol in Obese Lactating Women

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Abstract:
Background: Breastfeeding benefits both infants and mothers, but high maternal BMI can delay lactation and cause early weaning. Aerobic exercise may enhance milk production, breastfeeding frequency, and infant weight by improving chest blood flow. ***Aim of Study***: To explore the effectiveness of aerobic exercise on milk production and body weight in both mothers and their newborns among obese breastfeeding women. ***Methods:*** Seventy-two healthy multiparous women aged 25–35 years with a body mass index (BMI) between 30 and 40 kg/m², who developed lactation insufficiency within two months after normal vaginal delivery, were recruited from Kom Hamada General Hospital. Participants were randomized and equally distributed into a study group (n=36) and a control group (n=36). The study group performed supervised moderate aerobic exercises for 40 minutes, three times a week for six weeks, initiating 6–8 weeks postpartum, in addition to breastfeeding guidelines and nutritional and fluid intake advice. The control group received the same breastfeeding education without exercise. Serum prolactin levels, maternal weight, infant weight, and milk flow improvement were assessed before and after the six-week intervention. ***Results:*** Both groups (A & B) exhibited a significant increase in serum prolactin, baby weight, and milk flow (Visual Analogue Scale), and a significant reduction in maternal weight post- intervention ($P = 0.001$). But, no significant variations were noticed across groups in prolactin levels (pre: $P = 0.432$, post: $P = 0.0503$), maternal weight loss (pre: $P = 0.205$, post: $P = 0.965$), or baby weight (pre: $P = 0.409$, post: $P = 0.441$). For milk flow improvement, pre-study scores were similar ($P = 0.496$), but post-study, group A showed a significantly greater improvement than group B ($P = 0.048$).
Conclusion: Moderate aerobic exercise emerges as a safe, valuable adjunct to postpartum breastfeeding support, optimizing subjective lactation experience (improvement in milk flow) without compromising objective maternal-infant outcomes (Serum prolactin level, mother's weight, and weight of the baby).
Keywords: Breastfeeding, obesity, lactation insufficiency, aerobic exercise.
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1. Introduction

Breastfeeding is an essential aspect of motherhood that empowers women and fosters a sense of achievement through nurturing their infants. It serves an essential function in enhancing the health and wellness of moms and their kids, extending beyond nutritional benefits to form a cornerstone of long-term maternal and child health [1].

Breast changes in pregnancy and lactation are driven by estrogen, progesterone, and prolactin. Estrogen promotes ductal growth early, while progesterone stimulates lobular development later. After delivery, decreased estrogen and progesterone allow prolactin and oxytocin to initiate milk production, a process called lactogenesis [2].

Human milk develops in three stages: colostrum, transitional, and mature milk. Colostrum is protein- and immune-rich for newborn protection. Transitional milk becomes mature milk within two weeks, increasing in volume and providing full nutrients for infant growth [3].

Exclusive breastfeeding is advised for the initial six months to promote the health of both the newborn and the mother. It ought to be executed as needed, devoid of bottles or pacifiers. Supplementary foods are added safely at six months, while breastfeeding is maintained for two years or beyond [4].

Exclusive breastfeeding for the initial six months protects against infections and reduces infant mortality. It also supports long-term neurodevelopment, higher IQ, better educational outcomes, and lowers the likelihood of obesity and type 2 diabetes [5].

Breastfeeding benefits maternal health by aiding postpartum recovery, reducing hemorrhage, and accelerating uterine involution. Longer breastfeeding lowers postpartum depression and stress and decreases breast and ovarian cancer risks through hormonal effects [6].

Insufficient milk supply (IMS) is influenced by biological, behavioral, and social factors and may be primary, secondary, or mixed. Primary lactation insufficiency stems from developmental or endocrine disorders that impair glandular function. Breast hypoplasia is a key cause, while severe conditions like Sheehan's syndrome, infections, or hypertension can also contribute [7].

Secondary lactation insufficiency is caused by inadequate milk removal, often due to poor breastfeeding practices like improper latch, irregular feeding, or early formula supplementation, in contrast to primary insufficiency, which arises from maternal health or structural complications.[8].

Excessive weight loss, few wet or soiled diapers, poor stool color, lethargy, and weak sucking are signs of inadequate milk intake. By day four, a healthy infant should have a minimum of six wet diapers and three stools daily [9].

Females with a pre-pregnancy BMI ≥30 kg/m² face mechanical, hormonal, and psychological barriers, including delayed lactation, breast hypoplasia and body image issues that reduce exclusive breastfeeding, leading to earlier formula use and shorter duration [10].

Objectives of study

This research aimed to examine the influence of incorporating aerobic exercise alongside recommendations for breastfeeding, nutrition, and hydration, on the milk supply and body weight of both mothers and their newborns in obese lactating women.

2. Subjects and Methods

The research was performed at Kom Hamada General Hospital, El- Beheira Governorate, Egypt, from May 2025 to September 2025.

The Ethical Committee of Cairo University's Faculty of Physical Therapy has authorized the study, with approval number P.T. REC/012/003736. Additionally, this study protocol was recorded with ID NCT06975527 on ClinicalTrial.gov. Before giving written informed consent, participants were given the opportunity to ask questions and received full disclosure about the nature and objective of the study as well as the treatment methods.

2.1. Subjects Criteria

A. Inclusion criteria:

A total of seventy-two women contributed to this study according to the specified criteria:

Participants were multiparous obese mothers aged 25–35 years, with a parity of two to four and a BMI of 30–40 kg/m². They were within the second month postpartum following normal vaginal delivery, exclusively breastfeeding, and diagnosed with insufficient lactation by a certified breastfeeding consultant. All participants shared a similar nutritional status and educational background as middle-educated housewives.

B. Exclusion criteria:

Lactating women experiencing postpartum bleeding, inadequate mammary development, cardiopulmonary ailments, diabetes mellitus, breast tumor, subsequent pregnancies during lactation, psychological disorders, prior thoracic surgeries, anemia, or those with twins, as well as conditions impeding normal breastfeeding, including mastitis, cracked, or inverted nipples, or those taking contraceptive pills.

2.2. Outcome Measures

Assessment of serum prolactin level, mother's weight and BMI, weight of the baby and the degree of improvement in the flow of milk were performed before and after the end of the treatment procedures (6 weeks).

Assessment of Serum prolactin level

Blood samples were collected 30 min after the start of suckling, 3 to 4 hours after waking up in the morning at a sitting position [11]. The blood sample was then distributed and processed by mini VIDAS.

Assessment of mothers' weight

The weight-height scale was employed to assess the weight and height for every postpartum mother in both groups, after which body mass index (BMI) was computed using the subsequent formula: BMI = Weight (kg) / Height square (m²) kg/m² [12].

Assessment of the weight of the baby

The baby was weighed by being placed over the baby weight scale, wearing only the underwear, and removing the baby's diapers [13].

Assessment of the degree of improvement in the flow of milk

Each lactating mother in both groups had a visual analogue scale (VAS) and was asked to select the point that best represented their perceived level of milk flow [14].

2.3. Treatment Procedure

Seventy-two healthy multiparous mothers were randomized and equally distributed into two groups, **study group (group A)**: were engaged in a supervised moderate aerobic exercise (60: 70% HRmax) in the form of walking on a treadmill for

40 minutes/ day, 3 days weekly, for 6 weeks initiating 6:8 weeks postpartum in addition to guidelines for breastfeeding as well as proper maternal nutrition and fluid intake during lactation and **control group (group B)**: followed the same protocol as in group A except for the moderate exercise.

I. Breastfeeding guidelines and advices

1. Breastfeeding guidelines

- Breast Care: Wash hands/nipples with warm water (no soap); use warm/cold compresses and gentle massages (head, neck, shoulders, back, breasts) to promote milk flow [15].
- Feeding Readiness Cues: Start breastfeeding within 30 minutes of birth; feed on demand based on cues (crying, finger-sucking, rooting). Early frequent feeds build a 2–4 hour rhythm; prolong suckling for hindmilk [16].
- Proper Lactation Position: Cradle infant close, face-to-breast, maintaining straight posture with full body support. Side-lying and football holds are recommended for comfort, especially post-cesarean [17].
- Maternal Hand Placement: Brush nipple on infant’s lips, wait for a wide yawn-like open mouth, and latch to cover most of the areola. Support the breast using a "C" hold (thumb on top, fingers underneath) [18].
- Proper Latch & Milk Transfer: Signs of effective attachment include chin pressed to breast, mouth wide open, lower lip flared out, and a greater area of areola discernible above the lips. Incorrect positioning causes soreness and low milk transfer [19].

2. Advice about mother’s fluid intake and nutrition

- Caloric Intake: Increase daily intake by 500–670 kcal, especially during the first 6 months, to meet energy demands [20].
- Macronutrients: Consume 210 g/day of carbohydrates [21] and 1.05 g of protein/kg of body weight daily from meat, fish, eggs, milk, and legumes [22].
- Healthy Fats: Incorporate omega-3 fatty acids via fish or supplements to enrich breast milk and support infant neurodevelopment [23].
- Vitamins & Minerals: Supplementation of fat-soluble (A, D, E, K), B-group (B1, B2, B6, B12), and C vitamins, plus zinc, magnesium, selenium, and iodine impacts milk composition [20].
- Fluid Intake: Increase fluids to compensate for 700–780 mL/day lost to milk. Total daily water recommendations: EFSA (2.7 L), IOM (3.3 L), Chinese Nutrition Society (3.8 L) [24].

II. Aerobic exercise

The study group (Group A) was provided with lactation and dietary guidance while participating in monitored moderate aerobic training in the form of walking on a VEGAMAX 8000TC electric treadmill, which was manufactured in China, for 40 minutes/ session, 3 days weekly, for 6 weeks, initiating 6:8 weeks postpartum. Each exercise session was divided into 3 phases.

- Warm-Up Phase: Consisted of 5 minutes of low-speed walking within the participant's resting heart rate.
- Active Phase: Lasted 30 minutes at a moderate exertion of 60% to 70% of maximal heart rate (HRmax), which is estimated using the formula: HRmax = 220- age [25], with speed adjusted individually.
- Cool-Down Phase: Concluded with 5 minutes of gradually decreasing treadmill speed until the HR returned to resting values.

Sample size estimation

The sample size was determined utilizing G* Power statistical program (version 3.1.9.2; Franz Faul, Universität Kiel, Germany), referencing data provided by Lovelady et al. [26]. The assessment revealed that each group necessitated a total of 36 members. The computation was executed with a significance threshold (α) of 0.05, 80% statistical power, and an effect magnitude of 0.67.

Statistical analysis

Data were conveyed as mean ± SD. The unpaired t-test was utilized to assess comparisons among participants' traits of the two groups. The Shapiro-Wilk test was utilized to evaluate the data normality. A MANOVA analysis was executed to evaluate the intra-and inter-group impacts for the observed variables (prolactin serum concentration, maternal weight, infant weight, and the improvement in milk flow). Data analysis was performed utilizing SPSS (version 20 for Windows; SPSS Inc., Chicago, Illinois, USA). A p-value ≤ 0.05 was regarded as significant.

3. Results

As displayed in Table 1, the mean value of women age of groups A and B were (27.47±2.1) and (27.4±2.2) years, respectively, the mean value of women weight were (85.78±4.76) and (83.45±5.09) kg, respectively, the mean value of women height were (159.67±1.63) and (160.2±1.57) cm, respectively and the mean value of BMI were (33.87±1.84) and (32.51±1.89) kg/m2, respectively. There was no notable disparity in the average age, weight, height, and BMI of women across both groups (p> 0.05).

Table (1). Participants' demographics of the two groups

Demographic data	Group A (n=36)	Group B (n=36)	t-value	p-value
Age (years)	27.47±2.1	27.4±2.2	0.084	0.933
Weight (kg)	85.78±4.76	83.45±5.09	1.29	0.205
Height (cm)	159.67±1.63	160.2±1.57	-0.91	0.369
BMI (kg/m^2)	33.87±1.84	32.51±1.89	1.98	0.057

Data was represented as mean ± SD, p- value: significance

Within groups comparison

As displayed in Table 2, a statistically significant increase in serum prolactin levels was noted post-study in both groups (29% and 30%), respectively. For mothers' weight, a statistically significant reduction in the mean values was noted post-study in both groups (7% & 4%), respectively. There was also a substantial increase in baby weight post-study in both groups (58% and 42%), respectively. And finally, for the improvement in milk flow, a significant increase in the mean values was noticed post-study in both groups (197% and 125%), respectively.

Table (2). Mean ±SD of evaluated outcomes before and after study of the two groups.

Measured variables	Group A Mean ±SD	Group B Mean ±SD	MD (95% CI)	P-value^1	η^2
Prolactin level (ng/ml)					
Pre study	67.65 ± 36.33	58.87 ± 30.27	8.78 (-13.8, 31.4)	0.432	0.022
Post study	87.45 ± 43.43	76.66 ± 43.6	10.79 (-21.8, 43)	0.503	0.016
MD (95% CI)	-19.8 (-28.4, -11.2)	-17.79 (-26.4, -9.2)			
% of change	29%	30 %			
P-value	0.001*	0.001*			
Mother weight (kg)					
Pre study	85.78 ± 4.76	83.45 ± 5.1	2.33 (-1.4, 6)	0.205	0.057
Post study	79.97 ± 5.47	80.05 ± 5.21	-0.08 (-4.1, 3.9)	0.965	0.001
MD (95% CI)	5.81 (5.3, 6.3)	3.4 (2.9, 3.9)			
% of change	7%	4 %			
P-value	0.001*	0.001*			
Baby weigh (kg)					
Pre study	2.04 ± 0.33	2.17 ± 0.48	-0.13 (--0.4, 0.18)	0.409	0.025
Post study	3.23 ± 0.4	3.09 ± 0.4	0.14 (-0.16, 0.44)	0.441	0.031
MD (95% CI)	-1.19 (-1.3, -1.1)	-0.92 (-1.03, -0.81)			
% of change	58%	42 %			
P-value	0.001*	0.001*			
Improvement in milk flow					
Pre study	2.13 ± 0.83	2.4 ± 1.2	-0.27 (-1.06, 0.52)	0.496	0.017
Post study	6.33 ± 1.4	5.4 ± 1.06	0.93 (0.01, 1.86)	0.048*	0.132
MD (95% CI)	-4.2 (-4.73, -3.67)	-3 (-3.53, -2.47)			
% of change	197%	125 %			
P-value	0.001*	0.001*			

SD: standard deviation, *: significant, p-value: significant level intra-group, p-value^1: significant level inter-groups, CI: Confidence interval, η^2: partial eta square

Between-groups comparison

As displayed in Table 2, no statistically significant variations were noted in the mean values of serum prolactin level before and after the study across both groups (p= 0.432 & 0.0503), respectively. For mother weight, no significant variance in the mean values before and after the study across both groups (p= 0.205 & 0.965), respectively. Also, no statistically substantial change was noted in the mean values of baby weight before and after the study across both groups (p= 0.409 & 0.441), respectively. And finally, for the improvement in milk flow, no significant variation was noted in the mean values of the score before the study across both groups (p= 0.496), while a significant variation was indicated after the study (p=0.048), favoring group A.

4. Discussion

For Group (A) (study group), findings of the presenting study indicated that adding moderate aerobic exercise does not substantially enhance core lactation physiology or postpartum weight dynamics beyond standard lactational/ nutritional support. However, a subjective benefit from exercise was observed, likely due to enhanced mammary circulation, oxytocin release during activity, or maternal confidence boosting milk let-down efficiency despite unchanged prolactin [27].

The study findings are corroborated by **Lu *et* al.** [28]**,** who conducted an analysis involving two independent groups of lactating mothers: an exercise group comprising women engaging in both acute (single-session) and habitual (regular weekly) moderate-to-vigorous physical activity, contrasted with a control/low-activity group of sedentary or minimally active breastfeeding mothers. Although maternal weight reduction was not the main focus, the results suggest that physical activity during lactation positively influences milk composition without evidence of decreased supply, potentially aiding improved weight patterns for both mothers and infants.

The results also correspond with a randomized controlled trial (RCT) using faradic abdominal electrical stimulation combined with aerobic/resistive exercise in 54 overweight breastfeeding women (12 weeks postpartum). The addition of this combined exercise protocol to nutritional counselling resulted in significantly greater decreases in BMI, WHR, and LDL-cholesterol compared with counselling alone, indicating an enhanced impact on postpartum weight loss. Importantly, these changes occurred without reported deterioration in breastfeeding performance, suggesting that moderate, structured exercise can safely facilitate maternal weight reduction while preserving effective milk production in lactating women [29].

A systematic review of 29 RCTs (n=2575 postpartum mothers) supports that postpartum exercise safely promotes maternal weight loss without compromising lactation or infant growth. Predominantly walking-based moderate aerobic exercise significantly enhanced maternal cardiovascular parameters alongside modest weight reduction, without increasing injury risk. No adverse effects were observed on breast milk volume/supply, breastfeeding duration, infant weight gain, or developmental milestones, confirming structured exercise compatibility with effective lactation and healthy infant outcomes [30].

It was proven that moderate aerobic exercise combined with dietary modification is safe and effective in overweight/obese lactating women, as demonstrated by **Brekke *et* al.** [31] in a RCT of 68 Swedish women (BMI 25–35 kg/m², 10–14 weeks postpartum). The 12-week program featuring brisk walking (60–70% maximal heart rate, 4 sessions/week) plus diet changes produced significant improvements in cardiometabolic risk factors and body composition, including reduced central adiposity, without adversely affecting milk volume or infant growth.

For Group (B) (control group), the results demonstrate that lactational and nutritional counseling combined with weekly telephone follow-up produced statistically significant and clinically meaningful improvements across all measured outcomes. This confirms that even without a physical therapy or any hands-on intervention component, educational and supportive counseling alone has a real positive impact on lactation sufficiency, infant growth, and maternal body composition.

Aldana-Parra et al. [32] confirmed that structured breastfeeding counseling combining face-to-face sessions, telephone follow-ups, and nutritional guidance significantly improved breastfeeding rates, baby development, and maternal weight reduction in overweight postpartum mothers, supporting the present study's Group B findings.

The research findings are corroborated by **Abdollahi Apoorvari et al.** [33] by demonstrating that structured breastfeeding guidance grounded in the information-motivational behavioral skills approach significantly improved maternal BMI reduction, infant weight gain, and breastfeeding self-efficacy in postpartum women, confirming that targeted nutritional and lactational guidance effectively optimizes both maternal weight loss and infant growth through enhanced milk production and utilization.

Raju et al. [34] also demonstrated through a quasi-experimental study that breast massage performed three times daily over three days significantly reduced neonatal weight loss, improved infant feeding indicators (urination and stool frequency), prolonged infant sleep, and enhanced maternal confidence and milk production compared to standard postnatal care alone, highlighting breast massage as an effective non-pharmacological approach to optimizing early lactation outcomes.

5. Conclusions

The study results revealed that moderate aerobic exercise emerges as a safe, valuable adjunct to postpartum breastfeeding support, optimizing subjective lactation experience (improvement in milk flow) without compromising objective maternal-infant outcomes (Serum prolactin level, mother's weight, and baby's weight).

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Data access: On request, original data is available.

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