Provider Advice About Weight Loss and Physical Activity in the Postpartum Period

Renée M. Ferrari, Ph.D.,¹ Anna Maria Siega-Riz, Ph.D., R.D.,² Kelly R. Evenson, Ph.D.,³
Merry-K. Moos, F.N.P., M.P.H.,⁴ Cathy L. Melvin, Ph.D.,⁵ and Amy H. Herring, Ph.D.⁶

Abstract

Objective: To explore the association between healthcare provider advice about weight loss and physical activity in the postpartum period and weight retention and activity levels in women assessed at 3 months postpartum.

Methods: Using data from a prospective cohort study, we explored the association of advice with postpartum weight retention and activity levels in 688 women at 3 months postpartum. Data from home visits included anthropometric measurements and information collected from sociodemographic, health behavior, and psychosocial questionnaires. Weight retention was calculated as weight at 3 months postpartum minus pre-pregnancy weight; activity levels and advice were based on maternal self-report. Linear regression and Poisson regression were used to explore associations.

Results: The majority of the population was white (76%), had a greater than high school education (83%), and had an income >185% of the federal poverty level (81%). Women ranged in age from 17 to 48 years. Most women reported receiving no weight loss (89.1%) and no physical activity advice (77.4%) from a healthcare provider during the 3-month postpartum period. After adjustment, we found no association between provider advice and weight retention. When compared with those who reported no advice, following provider advice showed an association with recreational activity above the median (RR 1.50, 95% confidence interval [CI] 1.24, 1.80).

Conclusions: Provider advice may influence physical activity but may not be enough to help postpartum women lose pregnancy weight. Instead, women may benefit more from individualized counseling and follow-up beyond the usual 6-week postpartum visit.

Introduction

POSTPARTUM WEIGHT RETENTION may be an important contributor to the epidemic levels of overweight and obesity among reproductive-age women.^{1–5} Although average weight retention at 1 year postpartum is around 2.0 kg, the range of weight retention is highly variable (–3.5 to 26 kg),⁶ and some groups of women (14%–25% of the population) retain an excessive amount of pregnancy weight (>4.5 kg).^{3,7} Such findings suggest that a sizable number of postpartum women are at risk for excessive postpartum weight retention.

The 2002 American College of Obstetricians and Gynecologists (ACOG) guidelines for exercise during pregnancy and the postpartum period advise that postpartum women should resume regular activity gradually as medically advised.⁸

Studies of the benefits of physical activity for postpartum weight loss have yielded inconclusive results. Several studies found that physical activity postpartum aids women in returning to their prepregnancy weight and reducing overall weight retention,^{9–13} whereas other studies did not demonstrate such an association.^{14–16}

Although healthcare providers can be important sources of information about healthy weight loss and physical activity in the postpartum period, evidence in the literature is lacking. Studies outside of the postpartum period suggest that many women do follow the advice they receive from their providers, whether that advice is to get a mammogram, lose weight, or increase physical activity.^{17–19} Thus, the purpose of this study was to determine if provider advice regarding weight loss and physical activity, as delivered routinely in early postpartum, was associated with postpartum weight loss and

¹Department of Maternal and Child Health, ²Departments of Nutrition and Epidemiology, ³Department of Epidemiology, ⁴Department of Obstetrics and Gynecology, ⁵Cecil G. Sheps Center for Health Services Research, and ⁶Department of Biostatistics, The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

physical activity at 3 months postpartum. We also sought to describe the extent and nature of postpartum weight loss and physical activity advice given by healthcare providers as reported by women in early postpartum.

Materials and Methods

Study design and sample

Data are from the Pregnancy, Infection, and Nutrition Postpartum Study (PINPost), a prospective cohort study aimed at investigating factors related to weight retention in the postpartum period. PINPost followed women from pregnancy through 1 year postpartum. Women available for PINPost recruitment ($n = 1169$) included those enrolled in the Pregnancy, Infection, and Nutrition Study (PIN, details of which are described elsewhere²⁰) who gave birth to liveborn infants between October 2002 and December 2005, who said they were willing to be contacted for future studies, and who lived in the study's catchment area (required to conduct home visits). Then, 231 women were excluded for the following reasons: 24 had medical constraints that did not allow for their participation, 153 were unreachable, and 54 were > 5 months postpartum by the time we located them. Of the 938 women who were asked to participate, 688 (73.3%) agreed to participate and completed a 3-month interview in their home. This sample was compared both to the women who were excluded from the study ($n = 481$) and to the women who were eligible but refused participation ($n = 250$). There were no significant differences between the subpopulations, with one exception. Women who were excluded (i.e., not asked to participate) had a slightly lower gestational age and percentage of preterm birth compared with women with complete data at the 3 month time point.

Twenty-one of the live births (3.1%) represented siblings born to the same mother from two separate pregnancies. To remove issues of dependency, we dropped the second live birth, resulting in a final sample size of $n = 667$ women. For the weight loss advice analyses, we limited the sample to women with weight gain data, $n = 661$ (96.1% of the original sample of 688 women); for physical activity advice, we limited the sample to women with physical activity data, $n = 652$ (94.8% of the original sample).

Staff visited study participants in their homes at 3 months postpartum between April 2003 and March 2006. Visits lasted approximately 60–90 minutes and included height measurement using a standing height rod; weight and percent body fat measurement using a Tanita bioelectric impedance scale validated for use in an adult population²¹; an extensive interview covering sociodemographics, diet, physical activity, infant feeding, body image, health behaviors, psychosocial factors, and provider advice; and a food frequency questionnaire (FFQ) that assessed dietary intake in the 3 months prior to the home visit. The Institutional Review Board of the University of North Carolina at Chapel Hill approved all study protocols.

Exposure measurement: Postpartum advice about weight loss and physical activity

At the 3-month postpartum home visit, interviewers recorded maternal self-reports of postpartum provider advice about weight loss and physical activity. For both weight loss

and physical activity, participants were asked: (1) At any time since delivery has a doctor or a nurse or other health professional or have family members or friends given you advice about weight loss/physical activity or exercise after pregnancy? (yes/no). (2) Who gave you the advice? (select all that apply: doctor, nurse, other health professional [specify], nutritionist, midwife, internet, family member, friend). (3) What advice did they give you? (recorded verbatim). (4) Did you follow the advice that was given to you? (yes/no/other, specify).

Women reported advice from multiple sources, including provider and nonprovider sources. The sources of Internet, family member, and friend were combined into one variable of nonprovider advice; the remaining healthcare-related sources (doctor, nurse, midwife, WIC nutritionist, other healthcare provider) were grouped into provider advice. Advice was also dichotomized into two yes/no variables: received advice from any source and received advice from a healthcare provider. To explore the association of following provider advice, a three-level followed provider advice variable was created: received provider advice and followed it, received provider advice and did not follow it, and did not receive provider advice.

Interviewers recorded women's verbatim responses to the open-ended question: What advice did they give you? Responses were grouped into mutually exclusive categories and reviewed for clarity and content validity. Two researchers then independently coded each response and resolved any coding discrepancies by consensus. The number of responses per category was summed to obtain an overall number of women reporting advice in a given category.

Outcome measurement: Postpartum weight retention

Postpartum weight retention was calculated as the difference between measured body weight at 3 months postpartum and pregravid weight ascertained by maternal self-report at the first prenatal visit. Pregravid weights were checked for biological plausibility and compared with the weight recorded at the first prenatal visit. Large discrepancies were independently evaluated for reasonableness in light of gestational age at first prenatal visit. Unreasonable weights (3.8% of the sample) were replaced by imputed weights using a formula based on expected weight gain for a given gestational age. Two weight retention variables were generated: a continuous variable in kg and a three-level categorical variable of 0–2.2 kg, 2.3–4.5 kg, and >4.5 kg retention.

Outcome measurement: Physical activity

The physical activity questionnaire included questions about moderate and vigorous physical activity (defined as at least some increase in breathing and heart rate) in the areas of work, child care, transportation, household work, and recreation. Women were asked to recall their activities in the 7 days prior to the interview. For this analysis, the questionnaire was scored based on self-report of perceived intensity, whereby participants rated their activities as fairly light, somewhat hard, or hard/very hard. The length of time and frequency of participation in each activity were multiplied and summed for the week for each of the three intensity levels. Total activity was calculated by summing the time per week spent in all

reported activities. The questionnaire showed acceptable test-retest reliability.²²

Physical activity was examined both continuously and in tertiles. For total physical activity, we divided the continuous outcome into tertiles of low, medium, and high, using low as the referent category. We also created a categorical outcome variable for recreational activity. Two hundred nine participants (32.1%) reported no recreational activity. Because those reporting no activity represented a sizable and distinct group, we grouped them together. Based on the variable's distribution, we divided the remaining population at the median, separating subjects at or below the median from those above the median. Thus, the three categories for recreational activity were no activity (low), activity at or below the median (medium), and activity above the median (high). Those with no activity were coded as the referent category. Physical activity was also explored in terms of having met either the Centers for Disease Control and Prevention/American College of Sports Medicine (CDC/ACSM) recommendations for moderate activity (at least 30 minutes a day, 5 days a week, of moderate physical activity) or the ACSM recommendations for vigorous activity (at least 20 minutes a day, 3 days a week, of vigorous physical activity),^{23,24} creating the dichotomous outcome of MET recommendations.

Selected covariates

Covariates included potential effect measure modifiers and confounders identified *a priori* from the literature.^{25–27} Potential effect measure modifiers included self-reported importance of losing weight, prepregnancy body mass index (BMI), parity, adequacy of pregnancy weight gain,²⁸ and race. Race was used in the analysis as a sociological construct and not a genetic factor.

Potential confounders included sociodemographic characteristics that showed statistical association ($p < 0.2$) with weight loss advice or physical activity advice in the bivariate analyses. These included the potential effect measure modifiers as well as education level, marital status, and the dichotomous yes/no variables of working outside the home, paid child care help, depression, depression medication, and participation in an organized weight loss program, all self-reported at the 3-month postpartum visit.

Analysis

Chi-square and *t* test statistics were used to identify any differences in population characteristics by provider advice about weight loss and provider advice about physical activity.

Statistical modeling. Prior to assessing confounding, effect measure modification by each covariate was tested for each outcome by comparing the odds ratios (ORs) for each of the outcomes with and without the covariate. The outcomes for postpartum weight retention and physical activity included any advice, provider advice alone, provider advice and did follow it, and provider advice and did not follow it. Modification was considered present if the Mantel-Haenszel test for homogeneity detected a difference in ORs between groups ($p < 0.1$). All other covariates were assessed as potential confounders; those changing the coefficient by $>10\%$ were retained in each model.²⁹

For the weight loss analyses, received any advice, received provider advice, and followed provider advice were modeled on the two outcomes of postpartum weight retention as a continuous variable and as the three-level categorical variable. Few people reported having received advice and not following it, resulting in small cell sizes once we stratified by the three-level postpartum weight retention variable. To address this, retention was dichotomized as ≤ 4.5 kg and >4.5 kg.

Physical activity advice was modeled on five physical activity outcomes: total physical and total recreational activity (hours/week), as well as the total activity in tertiles, recreational activity (no recreational activity vs. medium recreational activity level, no recreational activity vs. high recreational activity level), and whether or not they met the CDC/ACSM recommendations for physical activity.

Linear regression was used to examine the outcomes in their continuous forms. The residuals for all linear regression models were assessed for normality using both a Q-Q plot of the residuals and an RXP plot comparing residuals to predicted values. The continuous outcomes did not violate the assumptions of linear regression. Multivariable analyses using a generalized linear model were used to estimate the adjusted relative risks (RR) and 95% confidence intervals (CI) for the categorical outcomes. Poisson regression was used with the categorical outcomes after attempts to use binomial regression models were unsuccessful (models would not converge).³⁰ Exact regression methods were used for the followed advice variables because of small cell sizes; there was no real difference in estimates or CIs; therefore, asymptotic methods were used for all models. Intercooled STATA 9.0 was employed for all statistical analyses (Stata Corp., College Station, TX).

Results

Table 1 presents selected sociodemographic and behavioral characteristics of the study population, stratified by provider advice about weight loss and provider advice about physical activity. The majority of the population was white, married, educated, and of high income. Age ranged from 17 to 48 years, with an average age of 31 years. Nearly half had weight retention of >4.5 kg at 3 months postpartum with a range of -16.8 to 23.0 kg. The vast majority did not meet the CDC/ACSM recommendations for physical activity.

Few participants reported receiving weight loss advice (23.8%) and physical activity advice (36.3%) from any source postpartum. Only 10.9% of the population reported receiving weight loss advice from a provider, and 22.6% reported provider physical activity advice. Among women who reported receiving advice from any source, the most commonly reported sources were physician, family, and friends (women were able to select more than one source). For weight loss advice, 42.8% reported advice from family, 33.3% from a physician, 29.6% from friends, 5.0% from a nurse, 4.4% from a nutritionist, 3.8% from another health professional, 3.1% from a midwife, and 0.6% from the internet. For physical activity advice, proportions for the same categories were 41.7%, 49.2%, 11.6%, 3.7%, 1.7%, 4.1%, 6.2%, and 0.0%, respectively.

Although given the option to report advice from multiple sources, 84.3% reported weight loss advice from a single source; 39% reported provider only advice, 54.1% reported

TABLE 1. DISTRIBUTION OF MATERNAL CHARACTERISTICS AT 3 MONTHS POSTPARTUM, OVERALL AND BY PROVIDER ADVICE ABOUT POSTPARTUM WEIGHT LOSS AND PHYSICAL ACTIVITY^a

Maternal characteristic	Total sample (n = 667)			Provider advice about weight loss			Provider advice about physical activity		
	n	%		Yes ^{b,c} (n = 73)		No (n = 594)	Yes ^{b,d} (n = 151)		No (516)
				n	%	n	n	%	n
Demographics									
Race/ethnicity									
Non-Hispanic Caucasian	509	76.4		43	58.9	466	121	80.1	388
Non-Hispanic African American	99	14.9		25	34.3	74	24	15.9	75
Other	58	8.7		5	6.9	53	6	4.0	52
Education level									
<High school	36	5.4		2	2.7	34	4	2.7	32
High school	81	12.1		14	19.2	67	12	8.0	69
> High school	550	82.5		57	78.1	493	135	89.4	415
Income status (% federal poverty level)									
≤185%	120	18.6		20	28.2	100	21	14.2	99
186%–350%	128	19.8		12	16.9	116	28	18.9	100
>350%	397	61.6		39	54.9	358	99	66.9	298
Marital status									
Single	111	16.6		20	27.4	91	21	13.9	90
Married	542	81.3		52	71.2	490	129	85.4	413
Separated, divorced, widowed	14	2.1		1	1.4	13	1	0.7	13
Age									
≤18	9	1.3		0	0.0	9	2	1.3	7
19–24	100	15.0		18	25.0	82	15	10.1	85
25–29	153	23.2		16	22.2	137	34	22.8	119
30–34	234	35.5		23	31.9	211	55	36.9	179
35+	164	25.0		15	20.8	149	43	28.9	121
Parity (live births + stillbirths)									
0 (nulliparous)	333	50.3		33	45.2	300	91	61.1	242
1	221	33.4		32	43.8	189	47	31.5	174
2	75	11.3		7	9.6	68	8	5.4	67
3+	33	5.0		1	1.4	32	3	2.0	30
Maternal health/health behaviors									
Breastfeeding									
Ever breastfed									
Yes	606	90.9		62	84.9	544	141	92.6	465
No	61	9.2		11	15.1	50	10	7.4	51
If yes, still breastfeeding									
Yes	427	70.5		37	59.7	390	104	73.8	323
No	179	29.5		25	40.3	154	37	26.2	142
Smoked since birth of baby									
Yes	81	12.1		10	13.7	71	8	5.3	73
No	586	87.9		63	86.3	523	143	94.7	443

Organized weight loss program	Yes	32	5.0	7	10.3	25	4.4	7	4.9	25	5.1
	No	606	95.0	61	89.7	545	95.6	136	95.1	470	95.0
Weight loss medication	Yes	8	1.2	1	1.4	7	1.2	0	0.0	8	1.6
	No	659	98.8	72	98.6	587	98.8	151	100.0	508	98.5
Weight and physical activity											
Prepregnancy BMI	Underweight	92	13.8	7	9.6	85	14.4	22	14.6	70	13.6
	Normal weight	363	54.6	30	41.1	333	56.3	82	54.3	281	54.7
	Overweight	77	11.6	7	9.6	70	11.8	13	8.6	64	12.5
	Obese	133	20.0	29	39.7	104	17.6	34	22.5	99	19.3
Pregnancy weight gain adequacy											
	Adequate	146	22.1	10	13.7	136	23.1	23	15.4	123	24.0
	Inadequate	94	14.2	13	17.8	81	13.8	23	15.4	71	13.8
	Excessive	422	63.8	50	68.5	372	63.2	103	69.1	319	62.2
Postpartum weight retention at 3 months postpartum											
	≤2.2 kg	225	34.0	24	32.9	201	34.2	50	33.6	175	34.2
	2.3–4.5 kg	133	20.1	11	15.1	122	20.8	29	19.5	104	20.3
	>4.5 kg	303	45.8	38	52.1	265	45.1	70	47.0	233	45.5
Importance of returning to prepregnancy weight											
	Not important	86	13.0	7	9.6	79	13.4	19	12.6	67	13.1
	Somewhat important	122	18.4	6	8.2	116	19.7	21	13.9	101	19.7
	Important	164	24.7	14	19.2	150	25.4	34	22.5	130	25.4
	Very important	291	43.9	46	63.0	245	41.5	77	51.0	214	41.8
Received provider weight loss advice											
	Yes	73	10.9	n/a	n/a	n/a	n/a	46	30.5	27	5.2
	No	594	89.1	n/a	n/a	n/a	n/a	105	69.5	489	94.8
Followed provider weight loss advice											
	Yes	57	78.1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	No	16	21.9	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Received provider physical activity advice											
	Yes	151	22.6	46	63.0	105	17.7	n/a	n/a	n/a	n/a
	No	516	77.4	27	37.0	489	82.3	n/a	n/a	n/a	n/a
Followed provider physical activity advice											
	Yes	100	72.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	No	38	27.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Met CDC/ACSM activity recommendations											
	Yes	117	17.9	16	22.2	101	17.4	31	20.8	86	17.1
	No	535	82.1	56	77.8	479	82.6	118	79.2	417	82.9
Physical activity		<i>n</i> = 652		<i>n</i> = 72		<i>n</i> = 580		<i>n</i> = 149		<i>n</i> = 503	
Total activity hours in last week		Median (IQR)		Median (IQR)		Median (IQR)		Median (IQR)		Median (IQR)	
Recreation activity hours in last week		4.6 (2.0, 9.6)		7.2 (2.4, 12.0)		4.5 (2.0, 9.2)		5.0 (2.7, 11.4)		4.5 (2.0, 9.1)	
		1.5 (0.0, 3.5)		1.4 (0.0, 4.0)		1.5 (0.0, 3.5)		1.5 (0.0, 3.5)		1.3 (0.0, 3.5)	

^aMissings uniformly excluded; percents may not add due to rounding.

^bChi-square test of overall distribution with received advice as the referent category; two-sided *t* test of sample means for continuous variables, *p* < 0.05.

Chi-square test of overall distribution with received advice as the referent category, two-sided t test of sample means for continuous variables, $p < 0.05$.

^dPhysical activity advice, statistically significant at $p < 0.05$ for education, parity, smoking status, weight loss advice, pre-pregnancy BMI, and postpartum BMI.^aInterquartile range.

nonprovider only, and 6.9% reported both provider and nonprovider. Similar proportions reported a single source of physical activity advice (83.9%), with 50.8% reporting provider only advice, 37.6% nonprovider only, and 11.6% both provider and nonprovider. Most women who reported receiving provider advice also reported following it (Table 1).

All covariates were tested for association with provider advice. Compared with those reporting no advice, a greater proportion of those who reported postpartum weight loss advice were African American, single, of a heavier pregravid weight, had self-reported depression and used depression medication, and were in organized weight loss programs. Those reporting physical activity advice were more often nulliparous, nonsmoking, and educated beyond high school ($p < 0.05$). No other factors were associated with advice.

Table 2 provides a summary of responses given by women who reported provider advice about either weight loss or physical activity in answer to the question: What advice did they give you? A total of 73 women (10.9% of the sample) reported provider weight loss advice, amounting to 103 distinct weight loss recommendations; 151 women (22.6%) reported 211 distinct physical activity recommendations from providers. Few women reported having received specific, detailed information about either weight loss or physical activity.

Receiving postpartum advice from any source was associated with greater weight retention at 3 months postpartum compared with no advice (data not shown). We found no association between any advice or provider advice with weight retention when we compared medium weight retention (2.3–4.5 kg) vs. low retention (≤ 2.2 kg) (results not shown). When we modeled high (> 4.5 kg) vs. low weight retention, we found a differing association by prepregnancy BMI (dichotomized as underweight/normal weight, or low BMI, vs. overweight/obese, or high BMI) (Table 3). Low BMI

women who reported weight loss advice from any source demonstrated a 30% increased risk of a > 4.5 kg weight retention compared with those reporting no advice, but there was no association among high BMI women. In the adjusted analyses, neither reported provider advice during postpartum nor following advice in postpartum was associated with weight retention (Table 3).

Women who reported receiving physical activity advice postpartum from a provider were more likely to report the highest tertile of total physical activity (RR 1.25, 95% CI 1.02–1.52) compared with women reporting no advice (Table 4). Women who reported following that advice were also more likely to report the highest tertile of total physical activity (RR 1.39, 95% CI 1.12–1.72) (Table 4). There was a modest association between reported advice from any source on recreational activity in the unadjusted analysis but no association between reported provider advice and recreational activity. In contrast, when compared with no advice, following provider advice did show an association with recreational activity above the median (RR 1.50, 95% CI 1.24–1.80) (Table 4). Linear regression analyses of weight retention and activity levels were consistent with the multivariable regression findings. No association was found between physical activity advice during postpartum and meeting recommendations for physical activity (data not shown).

Discussion

This study examined the association between reported provider advice in the postpartum period with weight loss and physical activity levels at 3 months postpartum. The postpartum visit typically occurs at 6 weeks postpartum. The current *Guidelines for Perinatal Care* suggest that the visit include a physical examination (including measuring weight) and an emotional assessment.³¹ The guidelines also advise

TABLE 2. NUMBER AND PERCENT OF PARTICIPANTS REPORTING POSTPARTUM PROVIDER ADVICE ABOUT WEIGHT LOSS AND PHYSICAL ACTIVITY, AMONG WOMEN REPORTING ANY ADVICE

<i>Weight loss advice</i>	<i>n = 73</i>	<i>%</i>	<i>Physical activity advice</i>	<i>n = 151</i>	<i>%</i>
Exercise/increase exercise	18	24.7	Encouraged/advised to exercise/be active: "Exercise."	50	33.1
Lose weight	14	19.2	Given permission to resume exercise/activity: "You can exercise."	36	23.8
Eat/drink healthy	14	19.2	Given permission to resume exercise/activity at future time	22	14.6
Reduce calories/carbohydrates/fats/sweets	10	13.7	Exercise for specified number days/week, time/day	18	11.9
Breastfeed	8	11.0	"Walk."	17	11.3
Give it time/don't worry about weight loss	8	11.0	"Take it easy/do not exercise."	13	8.6
Eat less	7	9.6	"Exercise/be active with some restrictions."	11	7.3
Eat enough while breastfeeding	7	9.6	"Lose weight/limit food intake."	8	5.3
Lose the baby weight within the first 6 months/first year or it will be very hard to lose	5	6.8	"Eat/drink well; do not limit food intake."	8	5.3
Participate in organized weight loss program	4	5.5	Provided specific information on exercising	6	4.0
Received written information to aid weight loss	3	4.1	"Do conditioning exercises to specific muscle groups (including sit-ups/crunches)."	5	3.3
Get social support to exercise/lose weight	1	1.4	"Do a specific type of exercise."	4	2.6
Do not diet/do not lose more weight	1	1.4	"Exercise with children."	4	2.6
Miscellaneous	3	4.1	Miscellaneous	9	6.0

TABLE 3. RELATIVE RISKS AND ADJUSTED RELATIVE RISKS OF POSTPARTUM WEIGHT RETENTION AT 3 MONTHS POSTPARTUM, BY PROVIDER ADVICE ABOUT POSTPARTUM WEIGHT LOSS AND WHETHER ADVICE WAS FOLLOWED^a

Model	>4.5 kg retention, low pregravid BMI		>4.5 kg retention, high pregravid BMI	
	Crude RR (95% CI)	ARR (95% CI)	Crude RR (95% CI)	ARR (95% CI)
Advice from any source ^b	1.46 (1.25–1.71)	1.31 ^c (1.14–1.49)	0.97 (0.72–1.30)	n/a ^d
Provider advice alone ^b	1.38 (1.13–1.69)	1.12 ^e (0.89–1.40)	0.80 (0.53–1.22)	n/a ^d
Received provider advice and followed it ^f	1.28 (1.09–1.49)	1.18 ^g (0.99–1.41)	0.91 (0.64–1.30)	1.09 ^h (0.74–1.60)
Received provider advice and did not follow it	1.05 (0.66–1.69)	0.91 ^g (0.61–1.35)	0.55 (0.22–1.39)	0.78 ^h (0.38–1.60)

^aNo advice was the referent category. Note that for all models, pregravid BMI was an effect measure modifier for >4.5 kg of weight retention, and estimates by BMI are, therefore, reported separately; for model 3, the outcome was dichotomized at ≤4.5 kg vs. >4.5 kg because of small cell sizes.

^bReferent is ≤2.2 kg weight retention.

^cAdjusted for maternal education and excessive pregnancy weight gain.

^dAdjusted estimate not applicable; no confounders identified.

^eAdjusted for adequacy of gestational weight gain and importance of losing weight.

^fReferent is ≤4.5 kg weight retention.

^gAdjusted for adequacy of pregnancy weight gain.

^hAdjusted for adequacy of gestational weight gain and participation in organized weight loss program.

RR, relative risks; ARR, adjusted relative risks.

covering topics related to family planning, breastfeeding, infant bonding, nutrition, and sexually transmitted diseases (STIs) and that practitioners refer women with chronic conditions to appropriate care.³¹ Advice about weight loss or physical activity is not included on the postpartum checklist provided in the guide.

The majority of women reported receiving no provider advice about weight loss or physical activity in the postpartum period. Our findings suggest little evidence of an association between reported weight loss advice, as provided in postpartum, and weight retention at 3 months postpartum. In contrast, physical activity advice suggested modest but potentially relevant associations with total and recreational activity.

Women who began pregnancy underweight or at normal weight had a slightly increased risk of >4.5 kg vs. ≤4.5 kg of weight retention when they reported receiving advice compared with no advice. It is possible that women with high retention may be more likely to receive or seek weight loss advice than women with lower retention precisely because they are in greater need of that advice. Although not statistically significant, there may be a greater risk of weight retention among women who stated they followed provider advice compared with those stating they did not follow it. This may be because of the small numbers of women who reported not following advice, which resulted in imprecise estimates with wide CIs. A larger sample would help elucidate any association between following provider advice and postpartum weight loss.

It is possible that the higher physical activity levels observed among women reporting advice are a direct result of provider advice. Another possible explanation is that the women with high physical activity postpartum had high physical activity levels before pregnancy, and these women more than others sought and followed advice about resuming their previous level of physical activity or were more likely to remember and report activity advice. Reported provider advice showed no association with meeting the recommenda-

tions for physical activity. There is insufficient research to draw conclusions about the role of advice in meeting recommendations.

The high proportion of women reporting that losing weight postpartum was important or very important suggests that provider advice about weight loss would likely be welcomed. In a study of women's postpartum health information concerns, the majority of women expressed a desire for more information about exercise and diet.³² In our study, however, a disappointingly high proportion of women reported receiving no provider advice whatsoever. Notwithstanding the broad needs of postpartum women for health information on such things as breastfeeding, infant health, and postpartum depression, not advising women about weight loss and physical activity at the postpartum visit is a missed opportunity to potentially influence women's health beyond the postpartum period. Several studies have shown that postpartum weight retention at 1 year is associated with movement into higher weight status groupings,^{33,34} which can predispose women to greater adverse outcomes in a subsequent pregnancy.^{35,36}

Although most women did not report receiving advice, a greater proportion of women reported having received physical activity advice compared with weight loss advice in our study, but we were unable to find previous studies for comparison. To our knowledge, only two other studies investigated provider advice about both physical activity and weight loss in the context of usual care, but neither reported the proportion of women receiving such advice.^{37,38}

A notable study strength is the inclusion of physical activity advice in addition to weight loss advice. A Cochrane review of postpartum weight reduction concluded that both physical activity and diet were important components of weight loss.³⁹ Importantly, our study also benefited from a clinically measured postpartum weight as well as a detailed, extensive questionnaire assessing time spent in a wide variety of physical activities. Participants were interviewed at 3 months postpartum about their physical activities in the week prior to

TABLE 4. RELATIVE RISKS AND ADJUSTED RELATIVE RISKS OF LEVEL OF TOTAL AND RECREATIONAL POSTPARTUM PHYSICAL ACTIVITY^a AT 3 MONTHS POSTPARTUM, BY ADVICE ABOUT POSTPARTUM PHYSICAL ACTIVITY AND WHETHER ADVICE WAS FOLLOWED^b

Model	Total physical activity				Recreational physical activity			
	Medium vs. low (2.9–7.5 hrs/week vs. ≤2.8 hrs/week)		High vs. low (>7.5 hrs/week vs. ≤2.8 hrs/week)		Medium vs. no activity (0.1–2.5 hrs/week vs. 0 hrs/week)		High vs. no activity (>2.5 hrs/week vs. 0 hrs/week)	
	Crude RR (95%CI)	ARR (95%CI)	Crude RR (95%CI)	ARR (95%CI)	Crude RR (95%CI)	ARR (95%CI)	Crude RR (95%CI)	ARR (95%CI)
Any advice	0.96 (0.79–1.18)	n/a ^c	1.23 (1.02–1.49)	n/a ^c	1.20 (1.00–1.43)	n/a ^c	1.10 (0.91–1.33)	n/a ^c
Provider advice alone	1.08 (0.87–1.35)	n/a ^c	1.25 (1.02–1.52)	n/a ^c	1.16 (0.95–1.41)	n/a ^c	1.12 (0.90–1.38)	n/a ^c
Received provider advice and followed it	1.16 (0.90–1.49)	n/a ^c	1.39 (1.12–1.72)	n/a ^c	1.34 (1.08–1.66)	1.21 ^d (0.95–1.54)	1.50 (1.24–1.80)	n/a ^c
Received provider advice and did not follow it	1.05 (0.72–1.53)	n/a ^c	0.94	n/a ^c	0.90 (0.61–1.33)	0.79 ^d (0.51–1.24)	0.37 (0.15–0.91)	n/a ^c

^aReferent is low activity for total physical activity and no activity for recreational activity.^bNo advice was the referent category.^cAdjusted estimate not applicable; no confounders identified.^dAdjusted for importance of losing pregnancy weight and caloric intake.

the interview, limiting recall bias. Although based on self-report, advice measurement included not only a question about whether advice was provided but also by whom, what the advice was, and whether it was followed. Multiple questions allowed for examination of advice in a variety of ways.

Interpretation of the present study results merits some caution. The study's observational nature prevents determining causation; that is, physical activity advice cannot be said to increase physical activity, nor can weight loss advice be said to decrease weight retention, but rather the results suggest such associations. We do not know exactly when the advice was provided and, thus, are unable to determine the timing of advice on weight loss or activity levels. However, temporality was present in the study—provider advice likely occurred before the assessment of weight loss and physical activity. Women who reported advice may have been those seen by a provider at the 6 weeks postpartum visit who had high retention but not enough time to lose the weight by the 3 month postpartum interview (in the United States, the 6-week visit is typically the first and only postpartum visit where the woman is seen by a healthcare provider for postpartum care). Another limitation worth noting is the measurement of advice, which is based on maternal self-report without evidence from providers or an objective evaluation of whether or how advice was provided (as could be achieved with videotaping of patient-provider interactions). The assumption is that provider advice was received at the 6 weeks postpartum healthcare visit, but this is not certain. Likewise, physical activity was based on maternal self-report, and it is possible that women overstated their physical activity levels. In addition, women were asked to recall physical activities that increased breathing and heart rate (indicating moderate to vigorous activity) but then were given the option of reporting the activity as fairly light, somewhat hard, hard, or very hard. Thus, the report of light activity is likely underreported, as we interpret activities reported as fairly light to be below moderate intensity.

The homogeneity of the sample is an additional study limitation; the majority of the study participants were white and highly educated, limiting generalizability to other populations. In contrast to other studies,⁹ this study did, however, include both breastfeeding and bottle-feeding mothers.

Conclusions

The provision of advice by healthcare providers stems from the premise that advice influences behavior. Our findings suggest that most postpartum women are not receiving postpartum weight loss or physical activity advice and also that advice alone may not be enough to help postpartum women lose pregnancy weight or increase physical activity levels. Instead, weight retention interventions^{37,38,40} lead us to believe that women, or subgroups of women, benefit more from individualized counseling and follow-up beyond the usual 6 weeks postpartum. Healthcare providers could serve an important role in advising postpartum women about healthy physical activity and weight loss, but few published studies were identified that explored this relationship.⁴¹ More work is needed to better understand what influence providers exhibit and how to maximize that influence. Future studies would benefit from a larger, more heterogeneous sample that could assess why advice was or was not followed. A better

understanding of provider advice about postpartum weight loss and physical activity would ideally assist providers in making advice relevant and effective, with the ultimate goal of helping postpartum women become more physically active and achieve a healthy weight during the postpartum period.

Acknowledgments

This study was supported by the National Institutes of Health (NIH)/National Institute of Child Health and Human Development (HD37584), NIH/National Cancer Institute (CA109804-01), NIH General Clinical Research Center (RR00046), and NIH/National Institute of Diabetes and Digestive and Kidney Diseases (DK 061981-02). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

The Pregnancy, Infection, and Nutrition 3 Study is a joint effort of many investigators and staff members whose work is gratefully acknowledged. In particular, we would like to acknowledge Drs. David Savitz, Nancy Dole, June Stevens, and John Thorp for their roles in PINPost study design and development.

Disclosure Statement

The authors have no conflicts of interest to report.

References

- Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among U.S. children, adolescents, and adults, 1999–2002. *JAMA* 2004;291:2847–2850.
- Linné Y, Dye L, Barkeling B, Rossner S. Weight development over time in parous women—The SPAWN study—15 years follow-up. *Int J Obes Rel Metab Disord* 2003;27:1516–1522.
- Rossner S, Ohlin A. Pregnancy as a risk factor for obesity: Lessons from the Stockholm Pregnancy and Weight Development Study. *Obes Res* 1995;3:267s–275s.
- Siega-Riz AM, Evenson KR, Dole N. Pregnancy-related weight gain—A link to obesity? *Nutr Rev* 2004;62:S105–111.
- Rooney BL, Schauburger CW. Excess pregnancy weight gain and long-term obesity: One decade later. *Obstet Gynecol* 2002;100:245–252.
- Gore SA, Brown DM, West DS. The role of postpartum weight retention in obesity among women: A review of the evidence. *Ann Behav Med* 2003;26:149–159.
- Olson CM, Strawderman MS, Hinton PS, Pearson TA. Gestational weight gain and postpartum behaviors associated with weight change from early pregnancy to 1 y postpartum. *Int J Obes Rel Metab Disord* 2003;27:117–127.
- ACOG Committee opinion. Number 267, January 2002: Exercise during pregnancy and the postpartum period. *Obstet Gynecol* 2002;99:171–173.
- Larson-Meyer DE. Effect of postpartum exercise on mothers and their offspring: A review of the literature. *Obes Res* 2002;10:841–853.
- McCrory MA. Aerobic exercise during lactation: Safe, healthful, and compatible. *J Hum Lact* 2000;16:95–98.
- Sampselle CM, Seng J, Yeo S, Killion C, Oakley D. Physical activity and postpartum well-being. *J Obstet Gynecol Neonat Nurs* 1999;28:41–49.
- Harris HE, Ellison GT, Clement S. Do the psychosocial and behavioral changes that accompany motherhood influence the impact of pregnancy on long-term weight gain? *J Psychosom Obstet Gynaecol* 1999;20:65–79.
- Ohlin A, Rossner S. Trends in eating patterns, physical activity and sociodemographic factors in relation to postpartum body weight development. *Br J Nutr* 1994;71:457–470.
- Schauburger CW, Rooney BL, Brimer LM. Factors that influence weight loss in the puerperium. *Obstet Gynecol* 1992;79:424–429.
- Boardley DJ, Sargent RG, Coker AL, Hussey JR, Sharpe PA. The relationship between diet, activity, and other factors, and postpartum weight change by race. *Obstet Gynecol* 1995;86:834–838.
- Walker LO, Freeland-Graves J. Lifestyle factors related to postpartum weight gain and body image in bottle- and breastfeeding women. *J Obstet Gynecol Neonat Nurs* 1998;27:151–160.
- O'Malley MS, Earp JA, Hawley ST, Schell MJ, Mathews HF, Mitchell J. The association of race/ethnicity, socioeconomic status, and physician recommendation for mammography: Who gets the message about breast cancer screening? *Am J Public Health* 2001;91:49–54.
- Sciamanna CN, Tate DF, Lang W, Wing RR. Who reports receiving advice to lose weight? Results from a multistate survey. *Arch Intern Med* 2000;160:2334–2339.
- Calfas KJ, Long BJ, Sallis JF, Wooten WJ, Pratt M, Patrick K. A controlled trial of physician counseling to promote the adoption of physical activity. *Prev Med* 1996;25:225–233.
- Mumford SL, Siega-Riz AM, Herring A, Evenson KR. Dietary restraint and gestational weight gain. *J Am Diet Assoc* 2008;108:1646–1653.
- Jebb SA, Cole TJ, Doman D, Murgatroyd PR, Prentice AM. Evaluation of the novel Tanita body-fat analyser to measure body composition by comparison with a four-compartment model. *Br J Nutr* 2000;83:115–122.
- Borodulin KM, Evenson KR, Wen F, Herring AH, Benson AM. Physical activity patterns during pregnancy. *Med Sci Sports Exerc* 2008;40:1901–1908.
- Pate RR, Pratt M, Blair SN, et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA* 1995;273:402–407.
- Pollock M, Gaesser G, Butcher J, et al. American College of Sports Medicine position stand. The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Med Sci Sports Exerc* 1998;30:975–991.
- Cogswell ME, Scanlon KS, Fein SB, Schieve LA. Medically advised, mother's personal target, and actual weight gain during pregnancy. *Obstet Gynecol* 1999;94:616–622.
- Taffel SM, Keppel KG. Advice about weight gain during pregnancy and actual weight gain. *Am J Public Health* 1986;76:1396–1399.
- Taffel SM, Keppel KG, Jones GK. Medical advice on maternal weight gain and actual weight gain. Results from the 1988 National Maternal and Infant Health Survey. *Ann NY Acad Sci* 1993;678:293–305.
- Siega-Riz AM, Adair LS, Hobel CJ. Institute of Medicine maternal weight gain recommendations and pregnancy outcome in a predominantly Hispanic population. *Obstet Gynecol* 1994;84:565–573.
- Rothman K, Greenland S. *Modern epidemiology*, 2nd ed. Philadelphia, PA: Lippincott-Raven, 1998.

30. Localio AR, Margolis DJ, Berlin JA. Relative risks and confidence intervals were easily computed indirectly from multivariable logistic regression. *J Clin Epidemiol* 2007;60:874–882.
31. American Academy of Pediatrics, American College of Obstetricians and Gynecologists, March of Dimes Foundation. Guidelines for perinatal care, 6th ed. Elk Grove Village, IL: American Academy of Pediatrics; Washington, DC: American College of Obstetricians and Gynecologists, 2007.
32. Moran CF, Holt VL, Martin DP. What do women want to know after childbirth? *Birth* 1997;24:27–34.
33. Scholl TO, Hediger ML, Schall JL, Ances IG, Smith WK. Gestational weight gain, pregnancy outcome, and postpartum weight retention. *Obstet Gynecol* 1995;86:423–427.
34. Nohr EA, Vaeth M, Baker JL, Sorensen T, Olsen J, Rasmussen KM. Combined associations of prepregnancy body mass index and gestational weight gain with the outcome of pregnancy. *Am J Clin Nutr* 2008;87:1750–1759.
35. Hedderson MM, Williams MA, Holt VL, Weiss NS, Ferrara A. Body mass index and weight gain prior to pregnancy and risk of gestational diabetes mellitus. *Am J Obstet Gynecol* 2008;198:409.e1–7.
36. Villamor E, Cnattingius S. Interpregnancy weight change and risk of adverse pregnancy outcomes: A population-based study. *Lancet* 2006;368:1164–1170.
37. Kinnunen TI, Pasanen M, Aittasalo M, Fogelholm M, Weiderpass E, Luoto R. Reducing postpartum weight retention—A pilot trial in primary health care. *Nutr J* 2007;6:21.
38. Leermakers EA, Anglin K, Wing RR. Reducing postpartum weight retention through a correspondence intervention. *Int J Obes Rel Metab Disord* 1998;22:1103–1109.
39. Amorim AR, Linne YM, Lourenco PM. Diet or exercise, or both, for weight reduction in women after childbirth. *Cochrane Database Syst Rev* 2007;CD005627.
40. O'Toole ML, Sawicki MA, Artal R. Structured diet and physical activity prevent postpartum weight retention. *J Womens Health* 2003;12:991–998.
41. Kim C, McEwen LN, Kerr EA, et al. Preventive counseling among women with histories of gestational diabetes mellitus. *Diabetes Care* 2007;30:2489–2495.

Address correspondence to:

Anna Maria Siega-Riz, Ph.D., R.D.

University of North Carolina at Chapel Hill

Gillings School of Global Public Health

Carolina Population Center, Campus Box # 8120

Chapel Hill, NC 27516-8120

E-mail: am_siegariz@unc.edu