



What Barriers Thwart Postpartum Women's Physical Activity Goals During a 12-Month Intervention? A Process Evaluation of the Nā Mikimiki Project

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Approximately 70% of new mothers do not meet national guidelines for moderate-to-vigorous physical activity (MVPA). The Nā Mikimiki ("the active ones") Project (2008–2011) was designed to increase MVPA among women with infants 2–12 months old. Participants' barriers to exercising and achievement of specific MVPA goals were discussed during telephone counseling calls over 12 months. Healthy, inactive women ($n = 115$, mean age = 31 ± 5 years, infants' mean age = 5.5 ± 3 months; 80% racial/ethnic minorities) received a total of 17 calls over 12 months in three phases. During Phase 1 weekly calls were made for a month, in Phase 2 biweekly calls were made for 2 months, and in Phase 3 monthly calls were made for 9 months. Across all phases, the most frequent barriers to achieving MVPA goals were: time/too busy (25%), sick child (11%), and illness (10%). Goals for MVPA minutes per week were achieved or surpassed 40.6% of the time during weekly calls, 39.9% during biweekly calls, and 42.0% during monthly calls. The least likely MVPA goals to be achieved

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($p < 0.04$) were those which the woman encountered and for which she failed to overcome the barriers she had previously anticipated would impair her improvement of MVPA. This process evaluation demonstrated that telephone counseling somewhat facilitated the resolution of barriers and achievement of MVPA goals; thus, if clinical settings adopted such methods, chronic disease risks could be reduced in this vulnerable population of new mothers.

KEYWORDS *postpartum, physical activity, goal setting, racial/ethnic minority, barriers*

INTRODUCTION

Motherhood is a significant change in a woman's life. It is usually a positive experience; however, health promoting behaviors, such as physical activity (PA), may be neglected due to a mother's shift in priorities to focus mainly on caring for her baby and other family-related issues (Albright, Maddock, and Nigg 2005, 2009; Haas et al. 2005; Olson et al. 2003). Consequently, most (70–80%) new mothers do not meet the national guidelines of 150 minutes per week of moderate-to-vigorous intensity physical activity (MVPA) (Albright, Maddock, and Nigg 2005; Pereira et al. 2007; U.S. Department of Health and Human Services 2008).

Studies of racial/ethnic disparities in MVPA, mostly conducted with African-American and Hispanic women, found that minorities are at a higher risk of inactivity or lower levels of MVPA compared to whites during pregnancy and postnatal periods (Albright, Maddock, and Nigg 2005; Boardley et al. 1995; Schmidt et al. 2006; Walker et al. 2012). Such low levels of physical activity places young adult women as they transition into parenthood, particularly racial/ethnic minorities, at risk for developing or exacerbating chronic health conditions potentially related to inadequate amounts of leisure-time PA, such as hypertension, obesity, and diabetes (Archer et al. 2013; Brown and Trost 2003; Downs, DiNallo, and Kirner 2008; Leslie et al. 2001; Olson et al. 2003; Robbins et al. 2013). Many of the studies that focused on the postpartum period primarily included white or African-American women (Chang, Nitzke, & Brown 2010; Clarke et al. 2007; Fahrenwald et al. 2004; Fjeldsoe, Miller, and Marshall 2010; Miller, Trost, and Brown 2002; Østbye et al. 2008, 2009), and therefore, little is known how postpartum women from other racial/ethnic minority backgrounds would respond to a long-term postpartum MVPA intervention.

A key component of many behavior change interventions is goal setting, whereby short-term, realistic, achievable goals for changing a specific behavior are set incrementally over time (Pearson 2012). Although previous studies with new mothers have encouraged goal setting (Fahrenwald et al.

2004; Fjeldsoe, Miller, and Marshall 2010), few studies have conducted process analyses to determine the responses of new mothers to setting goals for MVPA minutes per week and undertaking problem solving to address the barriers to those goals over the course of a 12-month PA intervention. Women's MVPA goals and barriers could change substantially as their babies grow and their lifestyle circumstances change (e.g., their baby becomes mobile, the woman returns to work, etc.).

The study (named "The Nā Mikimiki Project," translated as "the active ones" in Hawaiian) was a parallel randomized controlled trial that tested the efficacy of a tailored telephone counseling plus website (TTCW) PA intervention designed to initiate and maintain MVPA ($n = 154$) compared to a standard website-only (SWO) PA intervention ($n = 157$). The two websites were demonstrably different: one contained information that was tailored specifically to new mothers (TTCW), while the other website (SWO) provided standard, online information about how to become more physically active via links to credible sources (i.e., American Heart Association, etc.). The TTCW intervention consisted of telephone counseling sessions and a website, both of which were tailored to address a woman's specific MVPA benefits and barriers over a 12-month intervention (Albright, Maddock, and Nigg 2005, 2009; Albright et al. 2012). The types of barriers to MVPA new mothers reported over the course of a 12-month TTCW PA intervention, how frequently participants achieved their MVPA goals for minutes per week of MVPA, and the relation of persistent barriers to achievement of goals were quantified and compared.

MATERIALS AND METHODS

The study protocols and assessments were approved by the University of Hawaii's Human Studies Program and the Kaiser Permanente (KP) Institutional Review Board. All participants signed informed consent forms, and a Data Safety Monitoring Board oversaw recruitment, retention, and severe adverse events over the course of the study. A detailed description of the materials and methods used in the study are available elsewhere (Albright et al. 2012).

Eligibility

Women were eligible if they were healthy (no history of heart attack, stroke, or diabetes), inactive (<30 minutes of MVPA/week), 18 to 45 years of age, with infants between 2 and 12 months old, not pregnant or planning to become pregnant in the ensuing 12 months, had health insurance, read/understood English, had a body mass index (BMI) between 18.5 and 40 kg/m², and no plans to move out of state. Women were required to

provide a physician's written approval to join the study if they had severe complications during pregnancy/postpartum, were taking medication for a heart condition or hypertension, had exercise-induced asthma, experienced chest pain during MVPA, and had dizziness or orthopedic problems aggravated by MVPA (Canadian Society for Exercise Physiology 1994).

Recruitment and Study Condition Randomization

Between April 2008 and October 2010, 311 postpartum women were recruited from two sources: (1) paid advertisements or information distributed at community events, and (2) information was mailed to eligible members of Kaiser Permanente (KP). Advertisements were placed in the newspaper and in parenting magazines (provided free in pediatricians offices), and information about the study was distributed at a baby products fair. KP mailed a recruitment letter to 2,579 eligible members that included a mail-back card for women to use to indicate their interest, or lack thereof, in joining the study. Women who did not return a card within 2 weeks ($n = 327$) were called by KP staff to ask if they were interested in the study (Figure 1) (Albright et al. 2012). Women ($n = 691$) who were interested (either by returning the mail-back card, stating an interest to KP staff, or proactively calling/emailing the project's office) were screened over the telephone for eligibility.

Women who were eligible and signed a consent form were randomly assigned to one of two conditions, the first was a standard website-only (SWO) condition (i.e., only "standard" PA information was available on the SWO website). Participants in this condition did not receive any telephone calls or goal-setting advice about MVPA. The second consisted of tailored telephone counseling plus a website (TTCW) PA intervention designed to initiate and maintain MVPA using tailored resources, such as a condition-specific website, and 17 counseling calls focusing on goal setting, overcoming barriers to MVPA, and the importance of social support. The health educator helped women to problem-solve ways to overcome their barriers, highlighted the benefits of MVPA, and tracked current and future MVPA goals in reference to type of activity, duration, and intensity. The TTCW website contained 12 "resources" designed to facilitate MVPA, 19 behavior-change tip sheets, a monthly fitness calendar listing "baby friendly" community walks or yoga classes, etc., and 18 newsletters. The resources included lists of gyms with day-care facilities, maps to parks with "stroller friendly" paths, etc. At the end of each call a resource matching the woman's stated barrier was offered by the health educator and the participant could view it on the website, or it was sent to her as an email attachment or via U.S. mail. The women were told the website was updated 2–3 times per month; however, women were not encouraged to log in to the website on a certain schedule or for a specific number of times over the year.

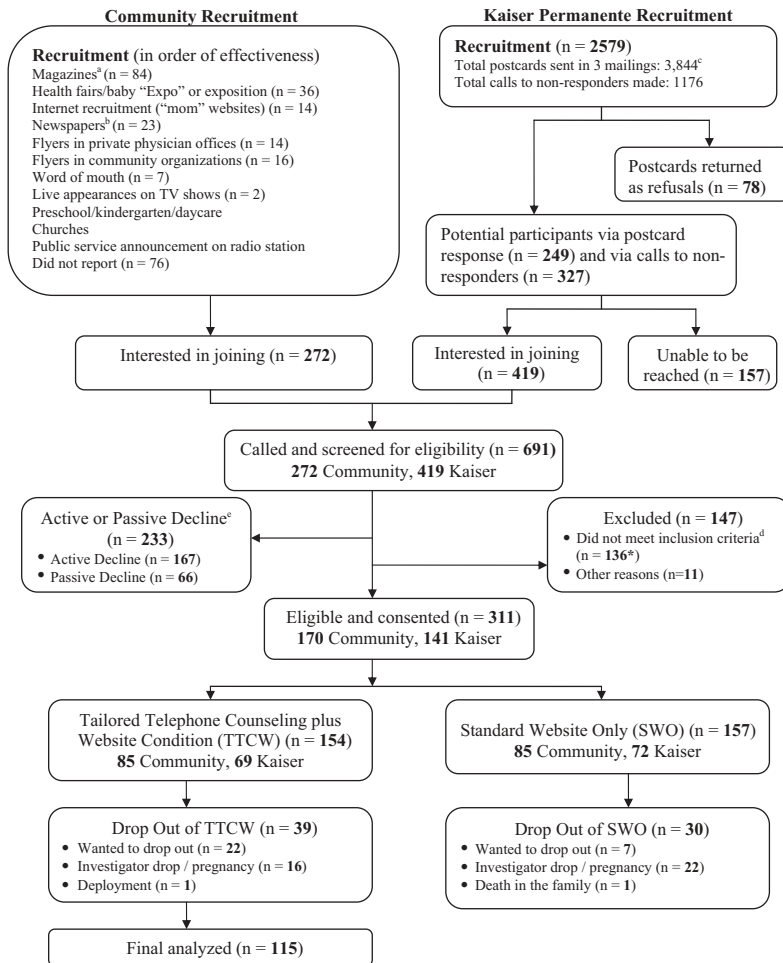


FIGURE 1 Accrual by recruitment method.

^aParenting magazines (readership): Island Family/Island Baby (45,000), Hawaii Parent (45,000), Hawaii Baby & Toddler (20,000).

^bNewspapers (readership): The University of Hawaii student newspaper (10,000), Honolulu Weekly (38,000), Star Bulletin (63,000), Star Bulletin: Progress (177,000), Midweek (268,000), Hawaii People (189,000), and Honolulu Advertiser (158,155).

^cKaiser Permanente staff sent a maximum of three postcards to mothers who met the basic eligibility criteria as determined by electronic medical records. For each recruitment attempt, eligible mothers were mailed a returnable postcard, followed by a phone call to non-responders.

^dDid not meet inclusion criteria because they were already exercising ($n = 66$), pregnant/planning to become pregnant ($n = 13$), using insulin ($n = 1$), planning to leave Oahu ($n = 7$), unwilling to complete assessments or office visits ($n = 4$), or BMI <18.5 ($n = 8$) or BMI >40 ($n = 9$), no health insurance ($n = 8$), cancer ($n = 5$), heart disease/attack ($n = 1$), stroke ($n = 1$), infant <12 months ($n = 1$), infant >12 months ($n = 7$), twins ($n = 2$), did not have GDM in last pregnancy ($n = 3$).

^eActive Decline = Declined to be scheduled for a baseline visit; Passive Decline = Failed to attend scheduled baseline visit or failed to attend baseline visit after being rescheduled three times.

During a counseling call the participant reported her current minutes per week of MVPA, and she listed any barriers she experienced while trying to achieve this goal. Following a brief discussion of her success (or not) with this goal, she set her next MVPA goal and identified any barriers she anticipated, which would keep her from achieving that future goal. The health educator discussed the feasibility of the future MVPA goal and problem-solved potential resolutions the woman might use to overcome her anticipated barriers. For example, the health educator asked: “Sometimes it helps to problem-solve barriers in advance. What, if anything, might keep you from doing your exercise over the next week (few weeks)?”

The intervention protocol consisted of 17 telephone counseling calls delivered over the course of 12 months, with the following schedule: Phase 1: weekly calls (for month 1); Phase 2: biweekly calls (for months 2 and 3); and Phase 3: monthly calls (for months 4 through 12, thus 9 months). Of the 154 randomized into the TTCW group, 115 (75%) set incremental MVPA goals with a health educator during telephone conversations over the entire 12-month intervention, and the analyses reported in the article are restricted to this subset. Because women were fairly inactive at the beginning of the intervention, their initial PA goals may have been set at a light intensity. However, they were encouraged to work up gradually to setting moderate-to-vigorous intensity physical activity (MVPA) goals. The initial “light” goals for minutes of PA per week were not included for the present analyses because goals set for MVPA minutes per week were the focus of the intervention.

Fidelity to the Protocol

Approximately 80 of the 1,586 recorded telephone counseling sessions (5% of the calls) were evaluated for fidelity. A checklist was developed that reflected the essential intervention components the calls were expected to address: daily steps accumulated on a pedometer (provided to women by the project), achievement of participant’s most recent MVPA minutes per week goal, setting of the woman’s next MVPA goal, discussion of social support and rewards for MVPA goals, problem-solving of barriers to the next MVPA goal (i.e., anticipated barriers), and discussion of MVPA resources selected to help participants overcome their barriers or to help them achieve their next MVPA goal. Fidelity over the 12-month intervention to these essential intervention components was 88%. The two most frequent components not delivered during a call were pedometer steps (asked 68.8% of the time) and MVPA resources (offered 80% of the time). Some participants did not use the pedometer continuously throughout the 12-month intervention, and if it was no longer used, the counselor did not ask about it in subsequent calls. Thus, when the pedometer usage was dropped as an essential component, the recalculation of fidelity for the remaining components was 91.3%. Because resources were tailored to the woman’s barriers and goals, she may not have

required MVPA resources after each call. Discussing barriers to MVPA was covered in 96% of the calls, assessing a woman's previous MVPA goal in 97% of calls, and setting the woman's next MVPA goal was discussed in 100% of the evaluated calls.

Measurement of Sociodemographic and Anthropometric Factors

Demographic and anthropometric data were collected at the baseline visit using standardized instruments (Østbye et al. 2008). The baseline survey assessed a woman's age, ethnicity/race, educational attainment, number of children, employment status, country of birth, marital status, lactation status, and her infant's age. Height and weight (Detecto scale, Model 448, Webb City, MO, USA) were measured in light indoor clothing, without shoes, following standard protocols (Frisancho 1990). Minutes per week of MVPA reported during the telephone counseling calls were used as outcomes in the present analyses.

Quantification of the Proportion of MVPA Goals Met

A participant's proportional achievement of her goal for minutes of MVPA per week was determined by dividing the current MVPA minutes achieved per week by the goal set for MVPA minutes per week during the previous counseling call. Minutes of MVPA were assessed during a call when a participant reported her physical activities each day over the previous week. For each reported PA, she provided information on the type of activity she had done (i.e., walking with her baby in a stroller, etc.), the intensity at which she exercised (classified as light, moderate, vigorous as defined in the Compendium of Physical Activities (Ainsworth et al. 2011)), and amount of time (in minutes) spent doing each type of PA. The questions about PA that a woman performed every day of the previous week were similar to questions used to quantify daily PA in the Stanford seven-day physical activity recall questionnaire (PAR), an interviewer-administered standardized measure for quantifying PA and energy expenditure (Sallis et al. 1985; Washburn et al. 2003). An evidence-based strategy was used when combining minutes of MVPA into a summary score that represented the total minutes of MVPA per week. The Metabolic Equivalent of Task or MET level for a generic vigorous physical activity is classified as 7 METs and the generic moderate physical activity is 3.5 METs (Ainsworth et al. 2011; Brown and Bauman 2000). Thus, to provide an accurate MET equivalent summary score for MVPA minutes per week, the minutes of vigorous activity were multiplied by two (i.e., 25 minutes of vigorous physical activity was calculated as 50 minutes of MVPA, whereas 25 minutes of moderate physical activity was classified as 25 minutes of MVPA) (Armstrong, Bauman, & Davies 2000; Brown and Bauman 2000). At enrollment participants were informed that their goal was to work

up gradually to achieving 150 minutes of MVPA, or 75 minutes of vigorous activity per week over the 12-month intervention (i.e., meeting the U.S. guidelines for adults (Haskell et al. 2007)). They were also informed as to what types of physical activities were classified as “moderate” versus “vigorous” intensity. Most women chose to exercise at a moderate intensity by walking with their infant in a stroller or at a vigorous intensity by jogging alone. Because many women used a combination of moderate and vigorous activities, using a single MVPA goal was easier to address in the goal-setting process and in calculating goal achievement. Thus, if a goal was set for two or more types of physical activity, both at a moderate or vigorous intensity, the minutes set for these two types were added together to create a goal for total minutes of MVPA/week. Several physical activity intervention studies and epidemiologic studies of MVPA across populations have combined minutes of moderate and vigorous physical activity using the “minutes of vigorous times two plus moderate intensity minutes” formula to summarize MVPA across a week (Armstrong, Bauman, and Davies 2000; Brown and Bauman 2000; Evenson, Brouwer, and Østbye 2013; Haskell et al. 2007; Moore et al. 2012; Tucker, Welk, and Beyler 2011).

The percent of goal that was set for minutes of MVPA that were achieved by the woman at the next call was classified into one of three categories representing goal achievement: low: 0–49% (achieved none or less than half of the goal set for minutes of MVPA); moderate: 50–99% (achieved half to almost the entire number of minutes set for the MVPA goal); and high: $\geq 100\%$ (achieved the goal set for minutes of MVPA or exceeded it). For example, if a woman set a goal of 30 minutes of MVPA for the next week and then reported she was able to do just 10 minutes, she would have achieved 33% of her goal minutes for MVPA per week, which would place her in the “low” goal achievement category. Both the duration and intensity of physical activities were factored into the total MVPA minutes per week. For example, if a woman set a goal to attend two, one-hour vigorous intensity aerobics classes (total of 120 minutes) and jog for 40 minutes ($120 + 40 = 160 \text{ minutes} \times 2$ for vigorous intensity or 320 minutes of MVPA/week) and then reported on the following call she jogged for 50 minutes and walked for 80 minutes over the previous week ($50 \text{ minutes} \times 2$ for vigorous intensity + 80 minutes for moderate intensity, or 180 MVPA/week), she would have achieved ($180/320$) 56% of her MVPA goal minutes, placing her in the “moderate” goal achievement category. Frequent types of exercise used for setting a goal for minutes of MVPA per week included: “walking with baby in a stroller,” “walking,” “aerobics class,” and “jogging.”

Barriers to Current and Future MVPA Goals

Barriers were categorized based on their association with the woman’s current goal or as an anticipated barrier to her next MVPA goal. The

barriers were further classified into distinct “types” of barriers based on the description provided by the participant (i.e., “too busy,” “child sick,” “bad weather”). To reflect the three intervention phases, the barriers were also identified as coming from the weekly, biweekly, and monthly phases of the 12-month intervention. For each specific intervention phase, each type of barrier was counted to determine the most frequent barriers for a current and future MVPA goal.

The barriers a woman anticipated getting in the way of her future MVPA goal were compared to the barriers she reported during the next counseling call that thwarted her attempt to meet her MVPA goal. Thus, the analyses investigated if anticipated barriers to MVPA goals “matched” the actual barrier experienced when she tried to achieve that goal over the ensuing week(s). If the anticipated barrier and the current barrier were the same (the barrier was not resolved), it was coded as “matched.” If multiple barriers were reported, the “matched” code was applied if any barrier matched in the subsequent call. If the anticipated barrier and the current barriers were different, it was coded as “not matched.” Finally, if the participant reported she had no anticipated or current barriers, this was coded as “no barriers.”

Statistical Analysis

The data were compiled with multiple records per person, up to 16 records for calls 2–17, which included an attempted goal, and a goal met and barrier matched determination. Barriers were counted from among those reported as having impeded progress on a goal or anticipated to interfere with goal attainment. Goal met and barrier match determinations were accomplished by linking each call record with the subsequent call and calculating and coding the variables as described above. Goal met was defined as ‘high’ achievement above ($\geq 100\%$). Goal met, coded as a binary variable, was regressed on intervention phase, barrier match status, and their interaction, including random intercepts per participant to control for dependency in the data due to repeated measures using PROC GLIMMIX, SAS version 9.2. Covariates examined were based on the literature and included age of baby, number of children, race, education, BMI, and work status (Barreira, Harrington, and Katzmarzyk 2014; Bastian et al. 2010; Biesmans et al. 2013; Braveman et al. 2010; Candelaria et al. 2012; Kull, Matsi, & Raudsepp 2010; Steffen, Albright, and Brown 2012; Walker et al. 2013; Wolfe et al. 1997); no interactions among covariates were assessed. This was a correlational approach testing for a relationship between a process measure and an outcome. Model fit was assessed using the ratio of the generalized chi-squared statistic and the degrees of freedom with values close to one suggesting a proper model.

RESULTS

Out of over 2,500 mailed recruitment letters to Kaiser members and thousands of print/radio/TV promotions/advertisements, internet postings, and community networking, 691 women were interested in joining the study and were screened for eligibility (see Figure 1). A total of 311 (45%) of these were eligible and enrolled, with approximately half randomly assigned to the TTCW ($n = 154$) and half into the SWO ($n = 157$) group (Figure 1). No significant differences were observed in baseline sociodemographic characteristics between the two randomly assigned conditions (Albright et al. 2012). Because we wanted to investigate resolution of barriers to MVPA goals and the subsequent achievement of MVPA goals over the entire intervention, data from 115 (74.7%) participants who completed the TTCW intervention were used in the present analyses. A majority (84.3%) of the 115 women in the TTCW condition were racial/ethnic minorities, specifically Asian (38.2%), Native Hawaiian/Pacific Islander (26.1%), and women with a mixed racial heritage (17.4%) (Table 1).

The most frequent reasons for failure to complete the intervention were pregnancy (13%—women who became pregnant could no longer receive MVPA counseling), too busy (9.5%), family/job issues (3.5%), and discontinued participation with no reason given (6.1%). Compliance to the scheduled telephone calls was high, with 90.4% of the postpartum women receiving ≥ 13 of the 17 scheduled calls, with a mean time per call of 12.7 (± 6.4) minutes. Most (78.3%) of the women in TTCW condition viewed the website at least once. They accessed the website 2,092 times for a mean of 17.7 pages viewed per person (among those who viewed the website at least once). Data linking the number of times each participant accessed the website between each specific counseling call and any subsequent barrier reductions after reading information on the website were unavailable.

Percent of MVPA Goals Met by Intervention Phase

The mean number of MVPA goals set per participant was 9.7 (± 4.0) over the 12-month intervention period. A total of 1,062 goals were reported by the 115 participants over the 12 months; each goal was classified into high, moderate and low achievement, as described above, based on physical activity goals and achieved levels of MVPA reported on the counseling calls in each of the three intervention phases (weekly, biweekly, monthly). A high level of achievement was reported 40.6% of the time during weekly calls (Phase 1), 39.9% during biweekly calls (Phase 2), and 42.0% during monthly calls (Phase 3). A moderate level of achievement was reported 23.5% of the time for Phase 1, 28.4% of the time for Phase 2, and 21.1% of the time for Phase 3. A low level of achievement was reported 35.8% of the time for Phase

TABLE 1 Baseline Sociodemographic Variables for the Tailored Telephone Counseling Plus Website (TTCW) Condition

Variable	Tailored telephone counseling plus website (<i>N</i> = 115)
Woman's mean age in years (SD)	32.3 (5.2)
Baby's mean age in months (SD)	5.1 (2.6)
Mean number of children (SD)	2 (1)
Mean BMI kg/m ² (SD)	27.7 (5.3)
BMI categories (kg/m ²)—Percentage (<i>n</i>)	
≤18.5	0.9 (1)
18.5–24.9	33.9 (39)
25–29.9	34.8 (40)
30–34.9	20.0 (23)
≥35	10.4 (12)
Race—Percentage (<i>n</i>)	
Asian	38.2 (53)
Japanese	6.1 (7)
Filipino	18.2 (21)
Mixed Asian/other Asian	13.9 (16)
Native Hawaiian/Pacific Islander	26.1 (30)
White	15.7 (18)
Mixed Race	17.4 (20)
Other (Black, Native American)	2.6 (3)
Ethnicity—Percentage (<i>n</i>)	
Hispanic	13.2 (15)
Number of children—Percentage (<i>n</i>)	
Primiparous	39.1 (45)
Two children	34.8 (40)
Three or more children	26.1 (30)
Employment—Percentage (<i>n</i>)	
No paid employment/family leave	37.4 (43)
Paid part-time	16.5 (19)
Paid full-time	46.1 (53)
Percent born in U.S. (<i>n</i>)	84.4 (97)
Education level—Percentage (<i>n</i>)	
Less than high school	3.5 (4)
High school graduate	14.8 (17)
Some college	22.6 (26)
Bachelor's degree	24.4 (28)
Post graduate	34.7 (40)
Marital status—Percentage (<i>n</i>)	
Never married	77.2 (88)
Married/living as married	21.9 (25)
Separated/divorced	0.9 (1)
Smoking—Percentage (<i>n</i>)	
Never smokers	77.2 (88)
Former smoker	21.9 (25)
Current smoker (4–20/day)	0.9 (1)
Any breast feeding—Percentage (<i>n</i>)	96.58 (111)
Percent (<i>n</i>) baby is mobile	22.6 (26)

TABLE 2 Levels of MVPA Goal Achievement across the Three Study Phases

Levels of MVPA goal achievement ^a	Study phases (%)		
	Weekly calls (1st month) (<i>n</i> = 187 ^b)	Bi-weekly calls (2nd–3rd month) (<i>n</i> = 268)	Monthly calls (4th–12th month) (<i>n</i> = 607)
Low	35.8	31.7	36.9
Moderate	23.6	28.4	21.1
High	40.6	39.9	42.0
Total	100	100	100
<i>F</i> (2,950) = 0.24, <i>p</i> = 0.79			

^aLevels of MVPA goal achievement categorized as: low = 0–49% (achieved none or less than half the designated goal minutes set for MVPA/week), moderate = 50–99% (achieved half to almost the entire number of goal minutes set), and high = ≥100% (achieved all or more of the goal minutes set for MVPA/week or more).

^bNumber of pairs of consecutive calls in which an anticipated goal was set during a counseling call and achieved minutes of MVPA were reported on the next call.

TABLE 3 Barriers That Thwarted Ability to Do Current MVPA (Top Five Barriers Listed)

Barrier	Study phases (%)		
	Weekly calls (1st month) (<i>n</i> = 232 ^a)	Bi-weekly calls (2nd–3rd month) (<i>n</i> = 202)	Monthly calls (4th–12th month) (<i>n</i> = 445)
Mom too busy	24.3	25.8	24.7
Bad weather	11.0	—	—
Child is sick	6.3	12.2	13.2
Mom too tired	6.1	—	—
Mom is sick	4.5	10.3	11.7

^aNumber of barriers reported in each study phase.

1, 31.7% of the time for Phase 2, and 36.9% of the time for Phase 3. The distributions of level of achievement (high, moderate, low) was comparable across the three phases (*p* = 0.79 for the *F* test) (Table 2).

Top Barriers Reported across Time

Women reported barriers for their current PA for that week as well as anticipated barriers for their future week(s) of PA (Table 3 and 4). The top barriers reported by participants were “too busy,” “bad weather,” “child or mom sick,” or “too tired.” The current barrier of being “too busy” was reported approximately 25% of the time and was mentioned as the anticipated barrier 22.2–33.7% of the time across the three intervention phases.

TABLE 4 Anticipated Barriers to Meeting Next MVPA Goal (Top Three Barriers Listed)

Barrier	Study phases (%)		
	Weekly calls (1st month) (<i>n</i> = 292 ^a)	Bi-weekly calls (2nd–3rd month) (<i>n</i> = 249)	Monthly calls (4th–12th month) (<i>n</i> = 397)
Mom too busy	33.7	25.8	22.2
Bad weather	23.4	16.9	—
Mom is sick	—	—	15.2
Child is sick	—	—	6.9
Mom too tired	8.5	8.4	—

^aNumber of anticipated barriers reported in each study phase.

Intervention Phase and Barrier Match to Predict Goal Met

To study the impact of meeting goals, a goal met value must have been available, two consecutive calls had to be completed, and the participant's PA goal had to be at the moderate or vigorous level. After controlling for age of baby, number of children, race, education, BMI, and work status, several factors were found to be related to meeting the outcome goal. Overall, racial differences occurred in goal met status (i.e., non-white racial/ethnic groups were less likely to meet their goal compared to white participants). Of all of the goals set, 21% had matched current/anticipated barriers associated with them, 64% had unmatched barriers (thus current/anticipated barriers were not the same), and 15% reported no barriers. Participants who did not anticipate any barriers and also did not report any current barriers ("no barriers") were the most likely to achieve $\geq 100\%$ of their MVPA goal minutes (61–84% of participants). Participants who were not able to problem-solve their anticipated barrier and therefore reported that same persistent barrier as a current barrier for the following week ("matched") were the least likely to achieve $\geq 100\%$ of their MVPA goal minutes (13–21% of participants) (Figure 2). This pattern differed across intervention phases in the magnitude of the differences, with a significant interaction between intervention phase and matched current/anticipated barriers ($F(4,943) = 2.56, p = 0.0375$). However, all had a similar pattern showing the most success when no barriers were reported and the least success when matched barriers were found.

DISCUSSION

In this analysis of participants randomly assigned to the tailored TTCW intervention condition in the Nā Mikimiki Project, both barriers (current and anticipated) and goals were tracked and analyzed over the study's three distinct phases in the 12-month intervention. Using theoretically derived counseling techniques, study counselors used behavior change constructs,

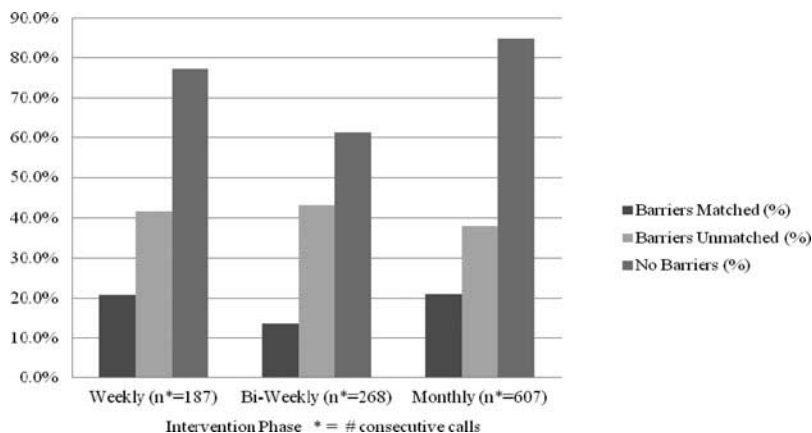


FIGURE 2 Of calls where 100% of MVPA goal minutes met, percent with no barriers, unmatched barriers, or matched barriers discussed per Intervention Phase.

such as goal setting, identification of barriers, and problem-solving ways, to overcome these barriers.

This analysis was unique in that our sample consisted of a multiethnic sample of women who were going through substantial transitions in their lives associated with motherhood, and their progress over the 12-month MVPA intervention was closely tracked and evaluated. Previous research of pregnant (Fjeldsoe, Miller, and Marshall 2010; Nicklas et al. 2011) and postpartum women recruited participants with a wider infant age range than our study's range of 2–12 months of age (Lewis & Ridge 2005; Nicklas et al. 2011). Cramp and Bray (2011) and Fahrenwald et al. (2004) recruited women with similarly aged infants as this study; however, Cramp's study did not investigate anticipated barriers and was conducted online. In addition, Cramp listed women's PA barriers at four time points (12, 18, 24, and 30 weeks) postpartum. Three barriers were mentioned most frequently (72.5% of the time) across all time points, with a range of 22.1–29.5% for “being tired,” 19–25.2% for “lack of time,” and 20.3–23.7% for “childcare duties.” Other barriers mentioned were physical limitations, weather, lack of motivation, lack of support, work, money, and depression.

Fahrenwald's analysis on WIC participants involved a guided interviewing style similar to motivational interviewing. However, barriers were chosen from a brochure that was developed using feedback from other WIC mothers, and therefore were tailored to postpartum women in general, but were not unique to each mother's personal situation. The current study not only categorized the types of barriers, but tracked how well barriers were overcome and if this process contributed to the achievement of the woman's MVPA goals over 12 months.

In our study, a significant interaction was observed between an intervention phase and barrier match in relation to whether a goal was met.

The main difference between the intervention phases was the number of calls and the time frame between calls. In the first month, participants received weekly calls from a health educator, which served as a steady source of social support during the initiation of regular MVPA. In the second and third month of the intervention, the calls were on a bi-weekly basis, and participants may have been affected by this decrease in social support/problem solving of barriers, which in turn could have affected their ability to meet their MVPA goals. By the time the third intervention phase occurred, calls were monthly and participants were getting accustomed to the protocol of setting their own weekly goals and using them for 4 weeks until the next call. During the first 3 months, health educators encouraged participants to establish a consistent source of support for physical activity, other than the health educator herself. This could possibly explain why the percent of goals met decreased during the bi-weekly intervention phase and then increased again in the monthly phase.

Although the intervention methods in other studies included counseling or problem-solving barriers to PA (Fahrenwald et al. 2004; Fjeldsoe, Miller, and Marshall 2010), they did not report the resolution of barriers to MVPA over the course of their intervention. One study did investigate barriers over time (Cramp and Bray 2011) but the authors did not investigate if resolved or unresolved barriers over time predicted if a goal was met or not. Our study participants reported similar PA barriers (too tired, lack of time, and childcare duties) reported in Cramp's (Cramp and Bray 2011) study on new mothers. Additionally, our top barriers to MVPA, both current and anticipated (too busy, bad weather, child/mom sick, too tired), were similar to barriers reported by mothers in other studies including: lack of motivation, fatigue, and time constraints (Fahrenwald et al. 2004; Lewis and Ridge 2005; Nicklas et al. 2011). As might be anticipated, mothers of infants reported barriers that involve their schedule or child care duties, which in turn decreases the time they can devote to purposeful bouts of MVPA.

Our analysis of goal setting and goal achievement is not new as other studies have looked at it in various populations including: health workers, obese individuals, Medicare beneficiaries, and Type 2 diabetics (DeWalt et al. 2009; Estabrooks et al. 2005; Pearson 2012; Sternfeld et al. 2009; West et al. 2010). The interventions in these studies were based on similar behavior-change constructs as ours. Goals that were specific, achievable, and short were associated with success in achieving intervention goals, as well as setting more challenging goals for themselves compared to having goals assigned to them (DeWalt et al. 2009; Estabrooks et al. 2005). In DeWalt's study on adults with type 2 diabetes, 71% of their sample achieved their goal and sustained their behavior at 2 weeks; however, only 33% continued to achieve their goals and sustain them at all three time points over the 3-month intervention. This is slightly less than our 40% for those who achieved

their goals, which gradually increased over the course of the 12-month intervention.

Our study also quantified those meeting their goals over time. In respect to goal setting and achievement of goals, we had explicit definitions for meeting goals compared to previous research done by Fahrenwald (Fahrenwald et al. 2004) and Fjeldsoe (Fjeldsoe, Miller, and Marshall 2010), both of which did not state how goal achievement was determined. Goal achievement for our study was found by comparing minutes of MVPA anticipated in a counseling call (goal) to minutes of MVPA reported in the following call, weighted for intensity. This was a concrete way of determining whether a goal was met based on the level of intensity and duration. Fahrenwald (Fahrenwald et al. 2004) reported that more participants in the intervention group showed greater improvements in PA and goal setting, as did Fjeldsoe (Fjeldsoe, Miller, and Marshall 2010) in her study of goal setting via text messaging. In Nā Mikimiki, only women in the intervention condition set MVPA goals, and a little less than half of their goals for MVPA minutes per week were achieved.

Limitations

The present sample of postpartum women may not be representative of all new mothers in Hawaii or the United States, given the relatively low participation rate and the fact that this sample consisted of women who were interested in becoming more active. However, this multiethnic sample provided a unique contribution to the literature as it included a sample of new mothers, tracked their achievement of MVPA goals, and attempted to address their barriers to MVPA over 12 months.

Additionally, as with any self-reported data, such as minutes of MVPA, errors such as recall bias or social desirability bias can occur. Also, our analysis only included participants who completed the intervention. Therefore, the percent of participants who achieved their goal may have been slightly inflated because those who withdrew from the study may have been less successful in achieving goals. This potential source of bias is inevitable with research that is conducted with volunteer participants. However, the most frequent reason for loss to follow-up in Nā Mikimiki was pregnancy (pregnant women could no longer receive MVPA advice due to safety concerns). Thus, missing data was not due to dissatisfaction with the intervention, inability to achieve MVPA goals, or a desire by the participant to stop being active.

CONCLUSIONS

The Nā Mikimiki Project examined the barriers faced by new mothers as they try to increase MVPA in their daily lives. About half of the MVPA goals

set over 12 months by the new mothers who received tailored telephone counseling, which included goal setting and overcoming barriers to MVPA, were achieved. This is important as many studies have reported that when mothers include MVPA in their daily life, they become a positive role model for their children as well as provide a healthy environment for their family (Fahrenwald et al. 2004; Lewis and Ridge 2005). Investigating barrier resolution over time and the consequential attainment of goals set for MVPA minutes per week over 12 months has not previously been reported for mothers with infants.

The significant transition to motherhood is a challenging time for women, specifically when they are trying to fit MVPA into their very busy life. Our sample of multiethnic women experienced a wide range of barriers to MVPA, similar to what has been reported in previous studies with postpartum women (Cramp and Bray 2011; Fahrenwald et al. 2004; Fjeldsoe, Miller, and Marshall 2010; Lewis and Ridge 2005; Nicklas et al. 2011), although our study was the only study to track barriers over a 12-month intervention period. This intervention identified the top barriers for women during three specific time periods: within one month of the baseline visit, between 2 and 3 months, and between 4 and 12 months. However, the types of barriers did not change substantially over a 12-month period. More research needs to be done to help mothers overcome these barriers to increase their PA while they are caring for a young infant.

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